

MAR 2 1923

Medical Lib.

VOLUME 9

NUMBER 3

ARCHIVES OF NEUROLOGY AND PSYCHIATRY

EDITORIAL BOARD

T. H. WEISNBURG, Philadelphia

ALBERT M. BARRETT, Ann Arbor, Mich.

HUGH T. PATRICK, Chicago

SAMUEL T. ORTON, Iowa City

E. W. TAYLOR, Boston

FREDERICK TILNEY, New York

MARCH, 1923

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH
DEARBORN STREET, CHICAGO, ILLINOIS. ANNUAL SUBSCRIPTION, \$5.00

Entered as second-class matter, Jan. 7, 1919, at the postoffice at Chicago, Illinois, under the Act of
March 3, 1879. Acceptance for mailing at special rate of postage provided for
in Section 1103, Act of Oct. 3, 1917, authorized Jan. 15, 1919.

CONTENTS OF PREVIOUS NUMBERS

JANUARY, 1923. NUMBER 1

Section of the Anterolateral Columns of the Spinal Cord (Chordotomy). Discussion of the Physiologic Effects and Clinical Results in a Series of Eight Cases. Charles H. Frazier, M.D., and William G. Spiller, M.D., Philadelphia.

Clinical Notes on the Pathology in a Case of Epidemic Encephalitis Complicated by a Psychosis. George B. Hassin, M.D., Chicago, and D. B. Rotman, M.D., Dunning, Ill.

Neurosyphilis Among the Chinese with Findings in Sixty-Five Cases. William G. Lennox, M.D., Peking, China.

A Study of Four Cases of Glossopharyngeal Neuralgia. John B. Doyle, M.D., Rochester, Minn.

Lesions in the Brain of a Patient with Post-encephalitic Paralysis Agitans. J. Charnley McKinley, M.D., Minneapolis.

The Pathologic Findings in the Heart Muscle in Progressive Muscular Dystrophy. J. H. Globus, M.D., New York.

Sex Development and Behavior in Male Patients with Dementia Praecox. Charles E. Gibbs, M.D., Ward's Island, N. Y.

Spirochete Stain in Multiple Sclerosis. George S. Stevenson, M.D., Ward's Island, N. Y.

Abstracts from Current Literature:

- Diaphragm Center in Cerebral Cortex and Hiccups.—Experimental Traumatic Shock.—Clinical Studies of Development of Schizophrenia.—Transplantation of Skin in Frog Tadpoles.—Elementary Convulsions in Ca-

tatonia.—The Visceral Sensory Nervous System.—Localization of Apraxia.—Palm-Chin Reflex.—Results of Puncture of Corpus Callosum.—Basal Metabolism in Non-toxic Goiter and in Borderline Thyroid Cases.—Tetany.—Contribution to Our Knowledge of Lesions of the Subthalamus Region.—Precipitating Situation in Two Hundred Cases of Mental Disease.—Experimental Diabetes Insipidus.—Hemiplegia with Hemichorea.—Development of Cranial Ganglia and Lateral Line Sense Organs in Amblystoma Punctatum.—Clinical Studies on the Cause of Schizophrenia.—Tuberose Sclerosis and Hydrocephalus.—Transitory Agnosia of an Infant.—Neurorecurrences Following Treatment with Arsphenamin.—An Unusual Calcification in the Brain.—Pituitrin as a Muscular Tonic.—Fundamental Plan of the Vertebrate Brain.—Recovery from Tuberculous Meningitis.—Traumatic Fractures of Cranial Bones.—Castes of Termopsis.—Cutaneous White Line.—Effect of Extract of Posterior Lobe of Pituitary on Basal Metabolism.—Fore-brain Morphology in Lower Vertebrates.—Diagnostic Value of Fluid Wassermann Reaction.

Society Transactions:
 Boston Society of Psychiatry and Neurology.
 Philadelphia Neurological Society.
 Book Reviews.

FEBRUARY, 1923. NUMBER 2

Genesis of Cerebellar Functions. Frederick Tilney, M.D., New York.

A Clinicopathologic Study of Acute and Chronic Chorea. George Wilson, M.D., and N. W. Winkelman, M.D., Philadelphia.

Two Cases of Brain Tumor with Ventriculography. Peter Bassoe, M.D., and Carl B. Davis, M.D., Chicago.

The Difference Between a Muscular and a Neuromuscular Interpretation of Walking. Walter M. Kraus, M.D., New York.

The Nature of Certain Functional Nervous Disturbances and Their Treatment Along Metabolic Lines. Ralph Pemberton, M.D., Philadelphia.

Abstracts from Current Literature:

- Syndrome of Central Gray Nuclei.—Focal Infection.—Functional Psychoses.—Oculogastric and Oculocolic Reflexes.—Solitary Tubercle of the Spinal Cord.—Neo-Arsphenamin in Hypodermic Injections.—Thorium X in Psychiatric Therapeutics.—Process of Ingestion in the Clute Frontalis.—Mechanism of Hallucinations.—Significance of Nystagmus in a Lesion of the Abducens Nucleus.—Schizophrenia.—

Pain in Threatened and Renal Gangrene of Extremities.—Physiology of Nervous System of Insects.—Venous Angioma of the Cerebral Cortex.—Progressive Muscular Dystrophy.—Diffuse Glia Reactions.—Spinal Spastic Paralysis.—Angioma of the Pons.—Recurrent Hypertrophic Neuritis.—Epileptoid or Fainting Attacks in Hypopituitarism.—Production of Neuromuscular Patterns.—Calcification of Pituitary with Hypopituitarism and with Symptomatic Treatment.—Asymptomatic Neurosyphilis.—Froin's Syndrome.—Colloidal Gold Reaction in Acute Epidemic Poliomyelitis.—Argyll Robertson Pupil.—Organization of Social Work in a State Hospital.—Bilious Attacks and Epilepsy.—Crawling of Young Loggerhead Turtles Toward the Sea.—Cerebrospinal Fluid.—War Psychoses.—Three Cases of Manganese Poisoning.

Society Transactions:
 New York Neurological Society.
 Boston Society of Psychiatry and Neurology.
 Chicago Neurological Society.
 Philadelphia Neurological Society.
 Book Reviews.

Archives of Neurology and Psychiatry

Vol. 9

MARCH, 1923

No. 3

THE DEEP SENSIBILITY OF THE FACE *

LOYAL E. DAVIS, M.S., M.D.

Fellow of the National Research Council

CHICAGO

Residual sensibility following various definite peripheral nerve lesions has afforded the material for many original and productive investigations. The contributions of Henry Head and his collaborators have marked an epoch in the study of the peripheral sensory mechanism, and the numerous nerve injuries encountered during the Great War gave added impetus to further experiments. By virtue of their comparative inaccessibility and the scarcity of verifiable clinical lesions, little is accurately known of the sensory distribution of the cranial nerves in man. This is quite true of the sensibility of the face, the cranial nerve supply of which must be the trigeminal or facial nerves or both.

Since Sir Charles Bell showed that facial palsy was dependent on a lesion of the seventh cranial nerve, for all practical purposes this nerve, with the exception of its chorda tympani branch, has been regarded as a motor nerve. The nervus intermedius without doubt carries these afferent fibers from the chorda tympani to the brain stem where they enter the tractus solitarius and course further cranialward. On the other hand, it has been commonly assumed that destruction of the trigeminal nerve results in the loss of all forms of sensation in the face and on the tongue, with the exception of taste. The perfection of the surgical technic in operations on the sensory root of the fifth cranial nerve for the relief of trigeminal neuralgia has afforded material for accurate clinical investigation of the sensibility of the face. On examination of the sensation of the face following trigeminal neurectomy, it was noted in a number of cases that deep pressure stimulation elicited a response, although all forms of superficial sensibility were lost. This led to the examination of all of the clinical cases for the absence or presence of deep sensibility and to the investigation of sensation following lesions produced in experimental animals.

* Contribution No. 103 from the Anatomical Laboratory, Northwestern University Medical School.

In studying the deep sensibility of the face, it has been my purpose to attempt to establish two points. Is pressure pain sensibility lost after division of the sensory root of the trigeminal nerve? If this type of sensation is not lost, do the fibers which transmit pressure pain travel cephalad in the facial nerve?

LITERATURE

In 1905, Henry Head¹ and his co-workers first called attention to the presence of fibers contained within the nerves supplying the muscles and tendons, which transmitted deep sensibility. These investigators found that following the division of all of the cutaneous nerves to a given area, stimulation with absorbent cotton, the prick of a pin, and warm and cold tubes produced no response, and the two points of the compass could not be discriminated. On the other hand, when this part was touched with any blunt object, the stimulus was at once appreciated, and the point of application could be localized quite accurately. Since all of the nerves which supplied the skin had been divided, the maintenance of this sensibility must have been due to afferent fibers running with the motor nerves. Sherrington² had already demonstrated the existence of such sensory fibers and traced them to the muscles, tendons and joints. The characteristic quality possessed by a part innervated solely by the afferent fibers of a muscular nerve is the appreciation of all stimuli which produced deformation of structure. Pressure or any jarring of the skin is quickly appreciated and, on the whole, well localized. Pressure is not recognized as a sensation when the skin is lifted from the underlying subcutaneous structures, thus demonstrating that this sensation is not due to nerves still remaining in the skin. Pressure produced by means of a Cattell's algometer elicits pain on the affected side, with a lesser degree of force applied than on the sound side. The sensory mechanism in the peripheral nerves was thus found to consist of deep sensibility, capable of answering to pressure and the movement of parts or even producing pain under the influence of excessive pressure; and the superficial sensory system which could be divided into protopathic sensibility, capable of responding to painful cutaneous stimuli and the extremes of heat and cold, and epicritic sensibility, which includes the power of cutaneous localization, of the discrimination of two points and of the finer grades of temperature.

1. Head, Henry: *Studies in Neurology*, London, Oxford Medical Publications **1** and **2**, 1920.

2. Sherrington, C. S.: On the Anatomical Constitution of Nerves of Skeletal Muscles, *J. Physiol.* **17**:211, 1894.

In his study of the cranial nerve components, Herrick³ states that while the twelve pairs of cranial nerves are fairly well defined in the human body, they are very diverse in the vertebrate series. Although the facial nerve is predominantly a sensory nerve in the lower vertebrates, it becomes a motor nerve in man with only a vestigial remnant of the sensory component. In studying *Menidia*, Herrick found many instances of distribution of visceral sensory fibers to regions in the mucous membrane of the mouth where there were no taste buds. Chiefly from anatomic evidence, he has classified the facialis as mediating general visceral sensibility. Dixon⁴ has shown rather conclusively in the lower mammals that the facial nerve is a mixed nerve and that its sensory part, the pars intermedia of Wrisberg and the geniculate ganglion, is similar in structure to the sensory portion of other nerves, and that the geniculate ganglion conforms to the cerebrospinal rather than to the sympathetic type.

Primitively, as shown by Johnston⁵ in the lamprey, the facial nerve contains two sensory components; that is, it possesses general cutaneous fibers arising from the geniculate ganglion for the innervation of the skin over the ventrolateral surface of the head below and behind the orbit, and other fibers terminating in the roof and floor of the mouth transmitting other visceral sensation as well as taste. Norris⁶ found a general cutaneous component in Siren. As Sheldon⁷ states, the facial nerve of the lower vertebrates, leaving out of consideration the lateral line component of the neuromasts, which is apparently only a part of the facial, is in every case a mixed motor and sensory nerve.

It will be recalled that the facial nerve in man makes its exit from the lateral part of the caudal border of the pons, with the nervus intermedius situated between it and the acoustic nerve. The facial then passes through the internal acoustic meatus and through the canalis facialis in the petrous portion of the temporal bone, emerges at the base of the skull by the stylomastoid foramen, and passes forward through the parotid gland to supply the muscles of the face. In the facial canal the geniculate ganglion is formed at the point where the facial nerve bends backward. From the ganglion, the greater superficial petrosal nerve passes forward through the hiatus canalis facialis

3. Herrick, C. Judson: Doctrine of Nerve Components and Some of Its Applications, *J. Comp. Neurol.* **9**:426, 1899.

4. Dixon, A. F.: Sensory Distribution of the Facial Nerve in Man, *J. Anat. & Physiol.* **33**:471, 1899.

5. Johnston, J. B.: Additional Notes on the Cranial Nerves of Petromyzonts, *J. Comp. Neurol.* **18**:569, 1908.

6. Norris, H. W.: The Cranial Nerves of Siren Lacertina, *J. Morphol.* **24**:245, 1913.

7. Sheldon, R. E.: Phylogeny of the Facial Nerve and Chorda Tympani, *Anat. Rec.* **3**:593, 1909.

to the middle fossa of the skull. Behind the tympanum in the lower part of the facial canal, the chorda tympani nerve arises. It enters the tympanic cavity, passes over the membrana tympani and leaves the cavity through the medial end of the petrotympanic fissure to reach the infratemporal fossa. Beneath the external pterygoid muscle it becomes incorporated with the lingual branch of the mandibular division of the trigeminal nerve, and is distributed to the side and dorsum of the tongue in its anterior two thirds.

Prior to the work of Van Gehuchten,⁸ investigators had not been in accord with reference to the origin of sensory fibers contained within the facial nerve. Some had considered them as arising from the trigeminal nerve and reaching the facial through the greater superficial petrosal. Others believed fibers from the auricular branch of the vagus nerve reached the facial. Weigner⁹ described fibers of small caliber, presumably intermedius fibers, in the facial nerve distal to the origin of the chorda tympani.

Streeter¹⁰ showed that at the fifth week the greater superficial petrosal nerve in the human is free from an anastomosis with the trigeminal nerve and that if any fibers grow into it from the fifth nerve they must do so at a very late date. The work of Retzius¹¹ and Lenhossek¹² demonstrated that the geniculate ganglion is composed of nerve cells identical with those of the cerebrospinal ganglia. The central prolongations of these cells enter into the constitution of the intermediate nerve of Wrisberg, while the external prolongations pass into the facial trunk. Van Gehuchten⁸ stained the geniculate ganglion in rabbits in which the facial nerve was sectioned as it left the facial canal. The majority of the cells of the ganglion were found to be normal. However, in every instance, he found a small number of cells which showed evidence of chromatolysis, such as dissolution of chromophilic elements and a considerable displacement of the nucleus. Amabilino¹³ sectioned the facial nerve on one side at the level of the

8. Van Gehuchten, A.: Recherches sur l'origine réelle des nerfs crâniens, *J. de chir.* **3**:273, 1898.

9. Weigner: Ueber den Verlauf des Nervus Intermedius, *Anat. Hefte* **29**: 97, 1905.

10. Streeter, G. L.: The Peripheral Nervous System in the Human Embryo at the End of the First Month, *Am. J. Anat.* **8**:285, 1908.

11. Retzius, G.: Untersuchungen ueber die Nervenzellen der Cerebrospinalen Ganglien und der übrigen peripherischen Kopfganglien, *Arch. f. Anat. u. Physiol.* 1880, p. 369.

12. Lenhossek, M. V.: Das Ganglion geniculi Nervi Facialis und seine Verbindungen, *Beitrage zur Histologie des Nervensystems und der Sinnesorgane*, Wiesbaden, 1894.

13. Amabilino: Sui rapporti del ganglio geniculato con la corda del timpano e col faciale, *II Pisani* **19**:2, 1898.

stylomastoid foramen and on the other side, the chorda tympani during its course in the middle ear. Four fifths of the cells of the ganglion showed definite chromatolysis on the side of the cut chorda tympani. Conversely, on the side of the cut peripheral trunk, about one fifth of the cells showed degenerative changes.

Edgeworth¹⁴ pointed out that the roots of the facial nerve consist of a large fibered portion and of fibers of a smaller diameter. The larger fibers of the nervus intermedius were found to be of all diameters up to 11.2 microns. All of the branches of the facial distal to its exit from the stylomastoid foramen consisted of gray and medullated fibers up to 11.2 microns in diameter. The chorda tympani consisted of medullated fibers of various diameters up to 11.2 microns. From examination of serial sections across the facial trunk in the bone, it appeared to this investigator that of the nerve fibers issuing from the geniculate ganglion, some of the medullated fibers separated off to form the chorda tympani, though a large number of the gray fibers joined the motor part of the facial and became mingled with these fibers. Edgeworth concluded that the muscles supplied by the facial nerve received muscle sensory fibers of all sizes up to a maximum diameter little short of that of their motor fibers.

Rhinehart,¹⁵ working with the albino mouse, stated that the facial nerve corresponds closely to that of other mammals and man. The nervus intermedius portion is composed of afferent fibers having their cell bodies in the geniculate ganglion and efferent fibers which have no connection with the cells of the ganglion. The nervus intermedius of the mouse has three branches; the greater superficial petrosal, the chorda tympani and a facial cutaneous branch. The first two contain both afferent and efferent fibers and the latter, afferent fibers only. These afferent fibers in the mouse terminate in the skin of the external auditory meatus, in the skin of part of the auricle and part of the tympanic membrane. There is no anatomic evidence which justifies the conclusion that such a branch exists in man. Hunt¹⁶ has offered some clinical evidence of the existence of such a nerve.

The experimental evidence offered in the literature points to the existence of afferent fibers within the peripheral facial trunk. The cells of origin of these fibers are in the geniculate ganglion and their internal prolongations pass cranialward in the nervus intermedius. From this evidence, however, the exact function of these fibers has not been

14. Edgeworth, F. H.: On the Medullated Fibers of Some of the Cranial Nerves and the Development of Certain Muscles of the Head, *J. Anat. & Physiol.* **14**:113, 1900.

15. Rhinehart, D. A.: Nervous Facialis of the Albino Mouse, *J. Comp. Neurol.* **30**:81, 1918.

16. Hunt, J. R.: The Sensory System of the Facial Nerve and Its Symptomatology, *J. Nerv. & Ment. Dis.* **36**:321, 1909.

proved. Evidence is at hand which leads to the conclusion that other cranial nerves or their motor divisions carry afferent fibers transmitting impulses from the muscles which they innervate. The origin and termination of the afferent fibers for the extrinsic muscles of the eye are unknown, although we know that such afferent fibers are present in the oculomotor, trochlear and abducens nerves. Johnston¹⁷ has shown that the large unipolar cells of the mesencephalic nucleus of the fifth cranial nerve, which give rise to the fibers of the mesencephalic root of that nerve, are probably sensory in function. Willems¹⁸ and Allen¹⁹ believe that these are sensory fibers to the muscles of mastication.

From the clinical standpoint several investigations have been reported, none of which appears to be sufficiently conclusive to settle the question of the presence of fibers in the fifth or seventh nerves which transmit deep sensibility. During his investigation of taste sensation on the anterior two thirds of the tongue following extirpation of the gasserian ganglion, Cushing²⁰ noted that after some days in association with the return of taste, the movement of a cotton swab over the surface of the tongue gave rise to a peculiar localizable tactile sensation. At the same time, anesthesia to pain, temperature and touch remained absolute. He expressed the view that it was not impossible that the chorda tympani may contain afferent fibers transmitting sensation other than that of taste from the anterior two thirds of the tongue. A patient in whom both the fifth and seventh nerve were paralyzed showed no sensation whatever over the anterior part of the tongue to touch, pain, temperature, taste or the movement of a swab over the surface. In addition, Cushing²¹ carefully studied the boundaries of the sensory loss on the face following trigeminal neurectomy. These observations were made by testing for the loss of superficial cutaneous sensibility only. Whatever afferent fibers may be contained in the facial nerve, he believes reach it by way of the greater superficial petrosal nerve.

Ivy and Johnson²² reported two cases from Frazier's clinic showing a retention of pressure sensibility after destruction of the fifth cranial

17. Johnston, J. B.: The Radix Mesencephalica Trigemini, *J. Comp. Neurol.* **19**:593, 1909.

18. Willems: Les noyaux masticateurs et mésencéphaliques du trijumeau, *Le Névraque* **12**:7, 1911.

19. Allen, W. F.: Application of Marchi Method to the Study of the Radix Mesencephalica Trigemini in the Guinea-Pig, *J. Comp. Neurol.* **30**:169, 1919.

20. Cushing, H.: Sensory Distribution of the Fifth Cranial Nerve, *Bull. Johns Hopkins Hosp.* **15**:213, 1904.

21. Cushing, H.: Taste Fibers and Their Independence of the N. Trigemini, *Bull. Johns Hopkins Hosp.* **14**:71, 1903.

22. Ivy and Johnson: Preservation of Deep Sensibility of the Face After Destruction of the Fifth Nerve, *U. of Pennsylvania M. Bull.* **20**:35, 1907.

nerve. One of the cases was a tumor of the gasserian ganglion, and the other was a complete section of the sensory root. No attempt was made to use a standardized or graded type of stimulation. Maloney and Kennedy,²³ in 1911, studied the relation of pressure touch and pressure pain fibers of the face to the facial nerve. For the purpose of their study they arbitrarily divided the facial nerve into four parts; (1) the peripheral portion of the nerve after its exit from the stylomastoid foramen; (2) that part of the nerve between the Fallopian aqueduct and the stylomastoid foramen; (3) that portion lying within the aqueduct, and (4) the central portion from the facial nucleus to the canal. Of their clinical material, there were eight cases of section of the second and third divisions, one case of section of the second division of the trigeminal nerve and ten cases of complete seventh nerve paralysis. For the purpose of their tests, they used an esthesiometer of 2 gm. weight and increased the pressure exerted by the addition of weights to 65 gm. They found uniformly that loss of sensation in the conjunctiva included all types of stimulation. Five cases showed that complete section of the facial nerve distal to the stylomastoid foramen may occur without loss of pressure pain sense. However, these were tested in the presence of cutaneous sensibility. These authors stated that this same finding may occur with a section of the nerve as high as the entrance of the facial nerve into the middle ear. On the other hand, pressure pain sensation was lost with a lesion in the Fallopian canal. They concluded that pressure pain sense is affected after intracranial interference with the trigeminal nerve, a procedure which they believe probably damages the functional activity of the sensory fibers of the facial nerve. This loss was permanent in some instances, so they reasoned that the fibers which join the facial nerve in the Fallopian aqueduct must first enter the region of the trigeminal roots. On the other hand, the constancy, severity and permanency of loss of all sensation in the eye indicated that the pressure pain fibers were invariably concentrated in the trigeminal nerve. It is obvious that such an explanation necessitates a fanciful anatomic pathway for fibers transmitting deep sensibility.

Applying Head's views on the peripheral nervous system to the facial nerve, Mills²⁴ argued that the afferent system concerned with deep sensibility, including pressure and postural senses, may be conveyed cranialward in the facial trunk, leaving it somewhere before it enters the cerebrospinal axis. He believed that the geniculate ganglion and its distal and proximal roots could be regarded on the basis of

23. Maloney, W. J., and Kennedy, R. F.: The Sense of Pressure in the Face, Eye and Tongue, *Brain* **34**:1, 1911.

24. Mills, C. K.: Sensory Functions Attributed to the Seventh Nerve, *J. Nerv. & Ment. Dis.* **37**:273, 1910.

homologues between spinal and cranial ganglions, such as the sensory portion of the facial nerve. He further predicated that if deep sensibility is relegated to a separate afferent system, the fibers should run with the motor fibers, although in a different direction. This would bring the facial and the motor portion of the trigeminal nerve into harmony with what Head believes to be the case in the spinal system. In Mill's work he deemed it essential that the condition as to cutaneous sensibility of the epicritic and protopathic types should be carefully determined. He concluded from his work that the sense of pressure pain was represented in the trigeminal and not in the facial nerve. In all cases of facial nerve paralysis investigated by this author, no alteration in the sense of pressure pain could be determined. Mills went a step further and argued that if Head's hypothesis held true with reference to pressure pain sense, then postural and passive movement sensation should be subject to the same alterations. He tested facial movements with a faradic current when cutaneous areas were totally anesthetic. Under these conditions his patients did not appreciate movement in the facial muscles. His final conclusion was that if the afferent fibers concerned with the sense of pressure posture and passive movement pass with the facial nerve, they diverge immediately after entering the cranium and join the sensory branches of the trigeminal nerve before the latter reach the gasserian ganglion.

Dana²⁵ believed that every form of sensibility is lost when the trigeminal nerve is cut close to the ganglion. This author reported a case in which the mandibular division of the fifth nerve was cut. The patient had lost sensibility to touch, pain, temperature, deep pressure sense and lacked recognition of movements of the facial muscles.

Davies²⁶ stated that deep sensation is invariably absent in regions in which there is a total loss of skin sensibility; in other words, he believed that sensory fibers from the muscles of the face travel in the trigeminal nerve. If the soft tissues were pressed upon the underlying bones, the patients said that they could feel a slight touch; yet if asked to indicate the spot, localization was imperfect. Postural changes of muscles produced by faradization or gentle traction on the lip or nose were not noticed, nor were the patients aware when the cheek became distended.

Kidd²⁷ asserts that if the seventh cranial nerve contains pressure pain fibers, they pass centrally by way of the pars intermedia. The

25. Dana, C. L.: Question of Protopathic and Epicritic Sensibility and the Distribution of the Trigeminal Nerve, *J. Nerv. & Ment. Dis.* **33**:577, 1906.

26. Davies, H. Morriston: Functions of the Trigeminal Nerve, *Brain* **30**:219, 1907.

27. Kidd, L. J.: Alleged Sensory Cutaneous Zone of the Facial Nerve of Man, *Rev. Neurol. & Psychiat.* **12**:393, 1914.

small size of this afferent root and its ganglion might suggest that this was impossible, for it has to transmit taste fibers as well. On the other hand, the deep afferent system needs a far smaller number of fibers for the transmission of its impulses than does the cutaneous epicritic system. Therefore, the afferent trigeminal tract may be looked on as an epicritic and protopathic nerve par excellence, whereas the afferent facial nerve probably conveys the relatively low grade deep sensibility fibers.

In reporting a case of tumor of the gasserian ganglion, Spiller²⁸ stated that tactile sensation was completely lost in the entire distribution of the fifth nerve, provided no pressure was used. The cornea was absolutely insensitive and pin prick sense was lost. He adds that in some cases of removal of the gasserian ganglion all sensation, including pressure sense, is lost, at least for a period following operation, but in two cases he had noted the preservation of pressure sense. Spiller believes that complete loss of all forms of sensation after excision of the gasserian ganglion does not make the transmission of certain forms of sensation through the seventh nerve impossible. On the other hand, deep sensation of the face may be interfered with by an operation on the fifth nerve.

METHODS

The methods for investigating the question of deep sensibility of the face may be divided into the examination of clinical cases and experiments performed on animals. The clinical cases consisted of trigeminal neurectomies and cases in which there was a simultaneous loss of the functions of both the fifth and seventh cranial nerves. Superficial sensation was tested in each instance by the use of an algesiometer of 15 gm. weight, a wisp of absorbent cotton and test tubes containing hot and cold water. Deep sensibility was investigated by the use of a Cattell algometer, the scale of which was graduated up to 15 kilograms. A reading was taken when the patient voluntarily manifested pain on pressure. Several readings were taken in each case over the ophthalmic, maxillary and mandibular areas of both the affected and unaffected sides.

Cats were used throughout the work as the experimental animals. Intracranial division of the sensory root of the trigeminal nerve or complete destruction and avulsion of the gasserian ganglion was performed on twenty-five animals. Aseptic measures were followed out in all operative procedures and the animals allowed to live varying lengths of time following the operation. Stimulation by means of an electric current was used to test the superficial and deep sensibility in the animals. Following the study of the sensation in each animal, they

28. Spiller, W. G.: Tumor of the Gasserian Ganglion, *Am. J. M. Sc.* **136**: 712, 1908.

were again operated on, and the facial nerve on the same side was sectioned at its exit from the stylomastoid foramen. The central end of the facial nerve was then stimulated with a sterile electrode in five of the animals. Again the animals were allowed to recover, and superficial and deep sensation of the face was tested. An electrode with needle points was used so that in testing for deep sensibility the points could be thrust beneath the cutaneous tissue into the muscles and on to the bones of the face. Postmortem examinations were made on each animal to determine the extent of the lesion involving the fifth nerve ganglion and definitely to prove that the seventh nerve was completely cut. In another series of eight animals, the facial nerve on the left side was cut at the stylomastoid foramen, and the lingual nerve containing the chorda tympani fibers was sectioned high on the right side. These animals were allowed to live about one week, when they were sacrificed and both geniculate ganglions were removed. A normal ganglion was carried through the staining preparations in each case in addition to the pathologic specimens, so that changes which might be produced by staining technic could be controlled. Toluidin blue-erythrosin was used as the staining fluid to determine ganglion cell degeneration changes, if such existed.

EXPERIMENTAL ANIMALS

Of twenty-five experimental animals, twenty-four showed responses from stimulation with an electric current which were exactly similar. It will suffice therefore to give in detail the protocol of one of these. The explanation of the responses obtained on the exception will be clearly seen in the protocol to be given.

The same technic used in producing the lesions of the fifth and seventh cranial nerves was adhered to in each animal. Under ether anesthesia the hair was removed from the side of the head to be operated on. The field of operation was painted with iodine and blocked off by sterile towels and sheets. A linear incision was made from the zygoma upward just in front of the ear. The fascia of the temporal muscle was incised and the fibers split in the direction of their course. They were held apart by a mastoid retractor, exposing the underlying bone. After all bleeding was controlled and with the zygomatic process as a base, a trephine opening was made through the bone. By the aid of small brain sponges, the dura was carefully separated from the floor of the middle fossa. An opening into the dura mater was carefully avoided. The temporal lobe was retracted upward and gauze dissection continued across the floor of the middle fossa to the gasserian ganglion. Considerable oozing was commonly encountered as the ganglion was exposed, but this could be controlled by pressure. After the ganglion had been completely exposed, a blunt nerve hook was passed beneath

it near the entrance of its sensory root. With a sharp right angled knife the sensory root was then divided. If trouble was experienced in visualizing the sensory root, the ganglion was completely avulsed. After hemostasis was secured, the wound was closed in layers and a collodion dressing applied. The animals recovered promptly and were tested for the presence of superficial sensation by a strong faradic current. These examinations were frequently repeated and the responses noted. After ten days to two weeks, a second operation was performed at which time the seventh nerve on the same side was cut at its exit from the stylomastoid foramen. After the operative recovery was complete, sensation was again tested by the electric current. Needle electrodes applied to the skin of the face with the secondary coil of the inductorium at zero was the unit of stimulation used to determine the presence or absence of superficial sensation. These electrodes could then be thrust through the skin into the facial muscles and stimulation effected to determine the presence or absence of deep sensibility.

Each animal was subjected to a postmortem examination to determine the extent of the lesion of both nerves. The geniculate ganglions of Animals 9, 11, 26, 27, 28, 29, 30 and 31 were studied for cell changes. In Animals 26 to 31 inclusive, the right lingual and the left facial nerves were cut and the respective geniculate ganglions studied by the toluidin blue-erythrosin method.

Protocol of Animal 9.—On Feb. 23, 1922, under ether anesthesia, the left sensory root of the trigeminal nerve of a female cat, weighing 3 kilograms, was severed. Hemorrhage was slight and a good exposure was obtained. The operative recovery was very prompt. On February 27, superficial stimulation with a unit of faradic current produced no response over the left half of the face, mucous membrane of the mouth or of the cornea. On thrusting the electrodes beneath the skin and into the muscles of the face, stimulation with the same strength of current produced a wild cry, struggling, pulling away and snapping. These responses were corroborated on March 1, 2, 3 and 5. On March 6, the left facial nerve was cut at the stylomastoid foramen. The nerve was cut some distance from the foramen and the central end carefully and completely isolated. It was then stimulated with a faradic current using a sterile electrode. A weak current caused the cat to cry out, and the right pupil dilated. A stronger stimulus produced struggling and an attempt to bite the investigator. The right pupil became constricted, but no change was noted in the left eye. The nerve was then cut close to the foramen. The animal again made a complete operative recovery. On March 9, at which time the facial paralysis was quite marked, the animal was again stimulated with an electric current. No response was obtained from superficial or deep stimulation on the left half of the face. These responses were corroborated on March 13 and 20 and on April 6. On April 7, the animal was killed and postmortem examination revealed a complete division of the fifth nerve posterior to the gasserian ganglion, as well as a complete severance of the facial nerve at the stylomastoid foramen.

Protocol of Animal 20.—The left gasserian ganglion and sensory root of a male cat, weighing 3.5 kilograms, were exposed, June 13, 1922. There was profuse bleeding from the cavernous sinus when an attempt was made to expose the sensory root more thoroughly. This was so troublesome that rather than prolong the operation, a nerve hook was placed beneath the ganglion and avulsion and destruction attempted. The animal made a very slow operative recovery, showing a definite left cerebellar ataxia for five days. On June 21, the animal was tested with a faradic current. The cornea was sensitive to the stimulation and to touch with a wisp of cotton. There was a small area the size of a ten cent piece over the maxillary eminence in which superficial stimulation produced no response. Elsewhere superficial sensation was present, including the mucous membranes of the nose and mouth. Stimulation with the electrodes placed beneath the skin and into the muscles of the face everywhere produced struggling and crying out. On June 26, the facial nerve was cut at the stylomastoid foramen. On June 29, 30 and July 2, several observations were made on this animal. Superficial stimulation with the faradic current produced the same response over identical areas as before. Stimulation deep beneath the skin produced struggling and crying out over the entire left half of the face. Postmortem examination showed that the lesion produced in the gasserian ganglion was quite incomplete. The sensory root was intact. There was a small lesion in the center of the ganglion which could be seen grossly. It was quite evident that division had not been accomplished.

CLINICAL CASES

The cases reported below for the most part are patients from the service of Dr. Allen B. Kanavel at Wesley Memorial Hospital. Each of the patients was completely examined, including a thorough neurologic examination. The superficial and deep sensation of the face was particularly investigated prior to operation, and each case was established as one of major trigeminal neuralgia. Following operation, each patient was again examined several times over periods varying from two weeks to three years after operation. Figure 1 is a composite diagram of the superficial sensory loss found in these cases. In any given case the line of sensory loss varied only about 0.5 cm. internal or external to this line.

CASE 1 (Mrs. C. S.).—On Jan. 15, 1922, the sensory root of the left trigeminal nerve was divided for the relief of a persistent trigeminal neuralgia which had been present for twelve years. Six alcoholic injections had been given previously, all of which had given relief. The last injection produced anesthesia and relief of pain for only one month. The dolorigenetic zone in this patient was at the left angle of the mouth, where stroking the skin with a wisp of cotton or a blast of cold air would produce the pain. Chewing and talking also excited pain from which the patient could get no relief. Following the operation sensation to pin prick, touch and temperature stimuli was lost over the entire half of the face bordered by a line corresponding to the average. The algometer readings over the left half of the face were: ophthalmic, 5 kgm.; maxillary, 2 kgm.; mandibular, 2 kgm. The corresponding readings over the right half were 2, 2 and 2 kilograms, respectively. The patient voluntarily described the sensation produced by the algometer as a crushing pain, and that

it seemed confined to the point of pressure on the left side, but on the unaffected side the pain was more radiating in character. These findings were corroborated on April 9, 1922.

CASE 2 (Mrs. F. C.).—In this case, division of the sensory root of the left trigeminal nerve had been performed six months previous to examination for the purpose of this work. When the operation was performed it had been quite possible to preserve the motor root. The boundary of the loss of superficial sensation was within the normal limits. However, it may be added that the cervical nerves did not overlap into the mandibular areas as far as in some of the other cases. The patient had perfect function of the left masseter and pterygoid muscles. On examination with the algometer, pressure pain responses

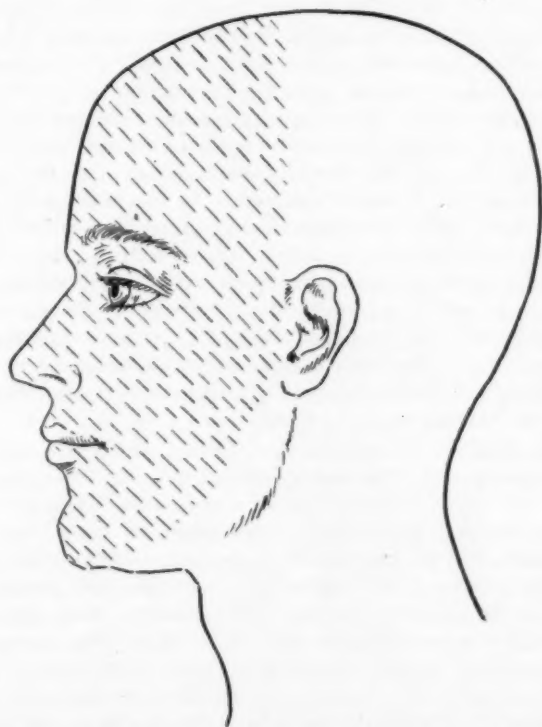


Fig. 1.—A complete diagram showing the loss of superficial sensation in ten cases of division of the sensory root of the trigeminal nerve for trigeminal neuralgia.

were present over both sides of the face. The readings were: left ophthalmic, 4 kgm.; maxillary, 2 kgm., and mandibular, 3 kgm.; right ophthalmic, 3 kgm.; maxillary, 2 kgm., and mandibular, 2 kgm. This patient described the sensation on the affected side as that similar to pressure on a sore tooth. No difference was noted in the radiation of the pain on the two sides. The two point discrimination test produced a correct response from the right side when the points were separated 2.5 cm. and when they were applied transversely. Correct responses could not be obtained on the left side with the points separated 4 cm.

CASE 3 (Mrs. L. M.).—A true major trigeminal neuralgia had been present on the right side for three years. Several deep alcohol injections had been attempted without the production of sensory loss, and consequently without relief of pain. The dolorigenetic zone in this patient was situated on the mucous membrane of the right cheek near the angle of the mouth. The pain would spread to involve the maxillary and ophthalmic division areas. The patient was examined one year following her operation, during which time she had had no recurrence of her pain. The right side of the face showed absolute loss to pin prick, temperature and touch sensation. The algometer readings were: right ophthalmic, 5 kgm.; maxillary, 3 kgm., and mandibular, 2 kgm.; left ophthalmic, 5 kgm.; maxillary, 3 kgm., and mandibular, 3 kgm. The patient described the sensation as an aching pain and could not distinguish any difference in severity on the two sides.

CASE 4 (Mrs. S. W.).—This patient was operated on two years ago (1920) for the relief of a right-sided trigeminal neuralgia. The records show that the patient had a facial paralysis of the peripheral type on the right side immediately following operation. This is an example of those fortunately uncommon paralyses which are most satisfactorily explained on the basis of traction on the greater superficial petrosal nerve at the time of operation and in which the patient more or less promptly recovers. At the time of my examination, no evidence of facial nerve involvement was present. The loss of superficial sensation was bounded laterally by a line situated well in front of the ear. The overlap from the cervical nerves was more extensive than the average. Pressure pain sensibility was present on both sides, as shown by these algometer readings: right ophthalmic, 2 kgm.; maxillary, 3 kgm., and mandibular, 2 kgm.; left ophthalmic, 2 kgm.; maxillary, 2 kgm., and mandibular, 2 kgm. The sensation was described as a "heavy pressing." Two point discrimination sense could not be accurately determined on the right side.

CASE 5 (Mrs. M. F.).—This patient had suffered with a left major trigeminal neuralgia for eight years. She had developed a habit of sucking in the left cheek between her gums to afford some slight relief. Talking, particularly, was an exciting factor. The terrific pain which had never been relieved by alcoholic injections had brought about a marked neurotic element. The left sensory root was sectioned, and immediately following the operation for four days there was a flaccidity of the left facial muscles. This had entirely disappeared at the time of her discharge two weeks later. The algometer readings made on the fourth day postoperatively were: right ophthalmic, 2 kgm.; maxillary, 5 kgm., and mandibular, 3 kgm.; left ophthalmic, 10 kgm.; maxillary, 12 kgm., and mandibular, 8 kgm. At the time of her discharge the readings were the same on the right side while on the left they were: ophthalmic, 5 kgm.; maxillary, 4 kgm., and mandibular, 3 kgm. These readings are somewhat higher than in the cases previously cited in comparison with the unaffected side. The facial nerve was no doubt affected in this case, but the temporary disturbance rapidly cleared up, and with it the algometer readings became more nearly normal. The patient signified that pressure had been applied at a lower reading, but the element of pain did not enter until the algometer had been depressed to the readings given. A round smooth piece of wood was introduced into each nares of this patient and pressure exerted laterally. The lacrimal reflex was obtained on the right side, as well as the sneezing reflex. On the left, the sneezing reflex was absent, but a lacrimal reflex was present.

CASE 6 (Mrs. I. M.).—The dolorigenetic zones in this patient's face were in the upper cheek on the right side, particularly on the mucous membrane opposite the second molar tooth. Difficulty was experienced in exposing the

sensory root because of adhesions previously induced by alcoholic injections. The ganglion was therefore completely avulsed. Sensation to pin prick, touch and temperature sense was lost over an area corresponding to the average loss. The algometer readings were: left ophthalmic, 2 kgm.; maxillary, 2 kgm., and mandibular, 2 kgm.; right ophthalmic, 3.5 kgm.; maxillary, 2 kgm., and mandibular, 3 kgm. The sensation produced on the affected side was a distinct one of a heavy, severe pressure, which did not spread. The patient could not discriminate one or two points over the affected side. Pressure inside the right nostril was felt, but not as distinctly as on the left. This pressure produced a lacrimal reflex on both sides.

CASE 7 (Mrs. M. S.).—This patient was operated on in July, 1922, for the relief of a major neuralgia, which had been present on the right side for two years. No alcohol injections had been given at any time. Following operation the patient had a paralysis of the right frontalis muscle, which was due to involvement of the frontal branch of the facial nerve in the operative incision. There was complete loss of superficial sensation in the trigeminal area. The algometer readings were: right ophthalmic, 14 kgm.; maxillary, 5 kgm., and mandibular, 3 kgm. The corresponding readings on the left side were: ophthalmic, 4 kgm.; maxillary, 3 kgm., and mandibular, 3 kgm. It will be seen that the reading over the right side of the forehead is high. Heavy pressure could be felt at all times, but it was not particularly painful. The readings were normal over the rest of the face.

CASE 8. (Mrs. H. C.).—A right trigeminal neuralgia had been present for six years. The first deep alcohol injection gave relief for two years. Later injections were unsuccessful. Following division of the sensory root, complete loss of superficial sensation was present over the usual area, except that there was a fairly wide overlap from the cervical nerves. The algometer readings were: right ophthalmic, 4 kgm.; maxillary, 5 kgm.; mandibular, 3 kgm.; left ophthalmic, 3 kgm.; maxillary, 2 kgm., and mandibular, 2 kgm. The sensation was described everywhere as a heavy crushing feeling, but was not distressingly painful.

CASE 9 (Mrs. T. H.).—This patient had suffered almost continuously since February, 1921 with a severe neuralgia of the left side of the face. Eating, talking and touching the face over the mandibular area caused an exacerbation of pain which spread over the entire fifth nerve distribution. A palpable thyroid gland was present, but there were no symptoms of pressure or of toxemia. The blood pressure was: systolic, 236; diastolic, 120. The patient withstood the operation very well, and there was an immediate relief from pain. The loss of superficial sensation here corresponded to the usual area. The algometer readings were: right ophthalmic, 2 kgm.; maxillary, 1 kgm., and mandibular, 1 kgm.; while on the left side they were ophthalmic, 2 kgm.; maxillary, 3 kgm., and mandibular, 2 kgm. The patient winced, but said that she did not know how to describe the sensation of the pain produced.

CASE 10 (Mrs. C. H.).—A right-sided major neuralgia which had been present for twelve years had brought this patient to the point of extreme emaciation and exhaustion. She had had four deep alcohol injections, but only one had been successful. Relief from pain lasted four months. On operation, dense adhesions were present between the dura mater and the floor of the skull. The ganglion was exposed with difficulty and eventually was avulsed. The sensory loss to pin prick, touch and temperature stimuli was within the usual borders. The patient could not accurately discriminate between one and two points applied to the face. The algometer produced a pain which was terrifying

to the patient. On the right side the readings were: ophthalmic, 3 kgm.; maxillary, 4 kgm., and mandibular, 2 kgm.; while on the left side the corresponding readings were: 3, 3 and 3 kgm. This patient noted that on the right side the pain did not radiate.

CASE 11 (Mrs. C. B.).—Four years before this patient developed a left peripheral paralysis of the facial nerve, which rapidly became better within two weeks. Subsequently, she began to have a neuralgic pain in the left side of her face, which began over the maxillary process and spread over the distribution of the maxillary and ophthalmic divisions of the trigeminal nerve. Cold air, cool water and stroking the face produced exacerbations of the pain. She suffered severely for a year and was referred by a neurologist for a neu-



Fig. 2 (Case 13).—Facial paralysis in the left frontal area. There was a complete loss of pin prick, touch and temperature sensation in the ophthalmic and maxillary division areas. The numbers within the circles represent the average readings of the algometer before pressure pain was produced.

rectomy as having a case of major neuralgia. Three years have elapsed since her operation. There is a complete loss of superficial sensation over the distribution of the left trigeminal nerve. Pressure with the algometer, however, produced definite pain localized to the point of stimulation over the left side of the face. The algometer readings were: right ophthalmic, 4 kgm.; maxillary, 3 kgm., and mandibular, 3 kgm.; left ophthalmic, 3 kgm.; maxillary, 2 kgm., and mandibular, 2 kgm. At this time, there was no evidence of any lesion of the left facial nerve. The motor division of the left fifth cranial nerve is paralyzed. The nasal mucous membrane on the left side is insensitive to pin prick, touch and temperature stimuli. Pressure with a blunt object within the nose produced a definite lacrimation in the left eye.

CASE 12 (Mr. C. R.).—This patient was examined in the neurological ward of the Cook County Hospital where he had entered complaining of bilateral disturbance of sensation of the face, diplopia and loss of taste sensation. The sensory loss in his face had its onset about a year previously and had begun in the region of the gums of the lower front teeth. The sensory loss began with a disturbance of heat and cold sensation, but as its area increased in size, the loss to pain became pronounced. At the time of examination, complete analgesia was present to pin prick stimulation over both trigeminal areas. Temperature sense was lost on the right side and was considerably impaired on the left. Touch sense, tested with a wisp of absorbent cotton was everywhere present. The patient had difficulty in distinguishing between sweet and sour stimuli over the anterior two thirds of the protruded tongue. No neuralgiform pain was complained of and the patient had no facial spasms. Argyll Robertson pupils were present, and the right pupil was larger than the left. The motor facial nerve was not clinically involved. Station and gait were normal and active, and passive movements were good. No paresis nor paralysis was present in any of the extremities. Pressure pain sense was present over both sides of the face as determined by pressure with the algometer. The readings were: right ophthalmic, 6 kgm.; maxillary, 5 kgm., and mandibular, 5 kgm.; left ophthalmic, 5 kgm.; maxillary, 5 kgm., and mandibular, 5 kgm.

CASE 13 (Miss C. L.).—This young Irish girl had been operated on two times at another hospital for the relief of a left-sided neuralgia. The scars of two osteoplastic flaps were visible. Although the patient had a total anesthesia to superficial cutaneous stimuli in the area of the ophthalmic and maxillary divisions, she still complained of severe pain in the mandibular area. This pain had its origin about the gums of the lower teeth on the left side. The left half of the forehead had been paralyzed since the branch of the facial nerve which supplies the frontal muscle had been cut in the skin incisions. Fig. 2 shows this paralysis quite clearly. The lower facial muscles were unaffected. The algometer readings were: right ophthalmic, 2 kgm.; maxillary, 2 kgm., and mandibular, 1 kgm.; left ophthalmic, 15 kgm.; maxillary, 2 kgm., and mandibular, 1 kgm. Pressure of 15 kgm. over the forehead, where both the fifth and seventh cranial nerve supply was absent, produced no sensation. Elsewhere over the face the algometer produced definite painful responses.

CASE 14 (Mr. F. H.).—This patient had been under treatment in the Ear Dispensary of the Northwestern University Medical School for many months for tinnitus, vertigo and loss of hearing on the right side. He rather suddenly developed a peripheral paralysis of the right facial nerve. Following this, over a period of eighteen months, the right trigeminal and glossopharyngeal nerves had also become involved (Fig. 3). The marked facial paralysis and the trophic lesion of the right eye are seen distinctly. On electric stimulation there is no response of the right facial muscles to either the faradic or galvanic currents. Sensation on the affected side is entirely lost to pin prick, touch and temperature sense. Pressure over the right half of the face with the algometer produces no sensation, even though the maximum stimulation of 15 kgm. is used. On the left side, pain is produced with a pressure of: ophthalmic, 3 kgm.; maxillary, 2 kgm., and mandibular, 3 kgm. Pressure with the algometer on the outstretched tongue produces pain, although sensation to the usual superficial stimuli, as well as taste sensation, is entirely lost over the right half of the tongue.

Figure 4 is a diagram on which have been placed the average readings obtained with the algometer in ten of the foregoing cases. Reading from left to right, the corresponding numbers on the left and right halves of the face represent a given case.

COMMENTS

From the evidence which has been gathered in the literature it appears to be well established that in the lower vertebrate series the seventh cranial nerve contains a sensory component, the fibers of which

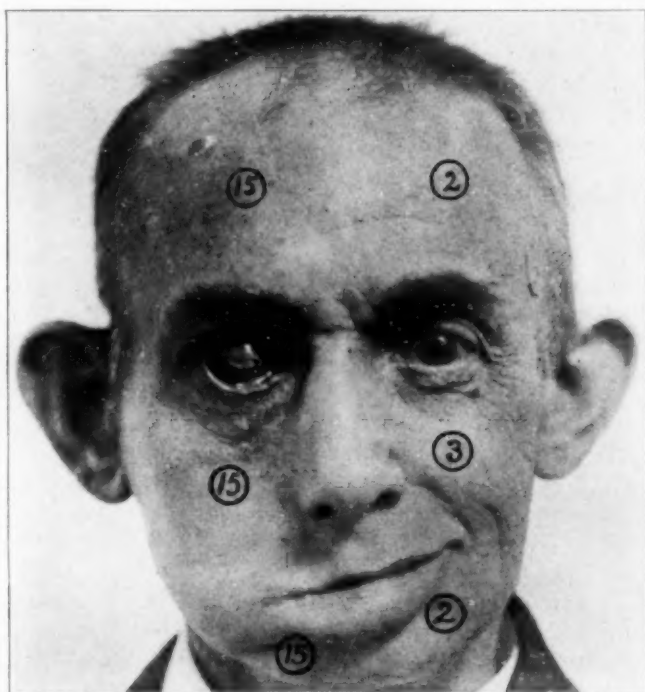


Fig. 3 (Case 14).—Trigeminal and facial nerve lesions on the right side. The numbers within the circles represent the average readings of the algometer before pressure pain was produced.

should probably be classed as general visceral afferent, since the muscles supplied by the facial nerve are of branchial origin. As one ascends in the mammalian series to man, the sensory portion of this nerve decreases in size. In man it is represented in the *pars intermedius* or the nerve of Wrisberg. It is here comparatively only a vestigial remnant. It can be easily understood, therefore, why the facial nerve should have been considered practically a pure motor nerve for so long a period. The demonstration that the taste fibers from the anterior two thirds of the

tongue course cranialward in the chorda tympani branch, the cells of which are in the geniculate ganglion, were signal observations. The most logical pathway for these afferent fibers cephalad from the geniculate ganglion would be within the nervus intermedius. These facts have been corroborated often and may be accepted. There need be no fanciful explanation which carries these impulses through the greater superficial petrosal to the gasserian ganglion, when a more direct anatomic course can be proved.

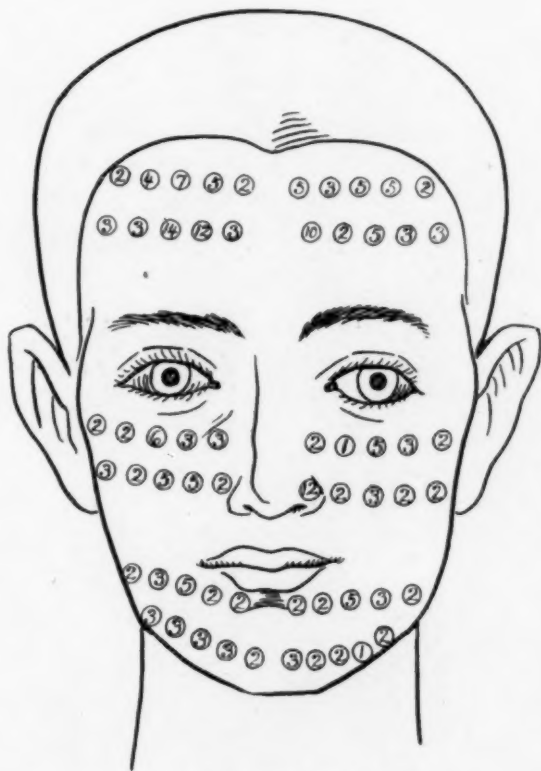


Fig. 4.—Average readings of the algometer producing pressure pain sensation in ten cases are shown within the circles. Reading from left to right in each area, the numbers represent the readings on the right and left sides in a given case.

In spite of these observations and those of Retzius, Lenhossek, Amabilino and Van Gehuchten on the histology of the geniculate ganglion cells and their changes after experimental lesions, the presence in the facial nerve of sensory fibers from the facial muscles has never been established. A review of the literature shows the opinion of the majority to be that destruction of the trigeminal nerve supply to the face produces a loss of all types of sensory stimulation. In most

instances, deep sensibility has been tested in an unstandardized manner, and results obtained from deep stimulation in the presence of perfect superficial cutaneous sensation are of little value. The supposed presence of muscle sensory fibers within the fifth cranial nerve has consequently called forth many explanations which have been quite unsubstantiated from an anatomic standpoint. These have predicated the supply of the facial muscles with sensation directly from the trigeminal nerve, or the presence of these fibers within the facial nerve

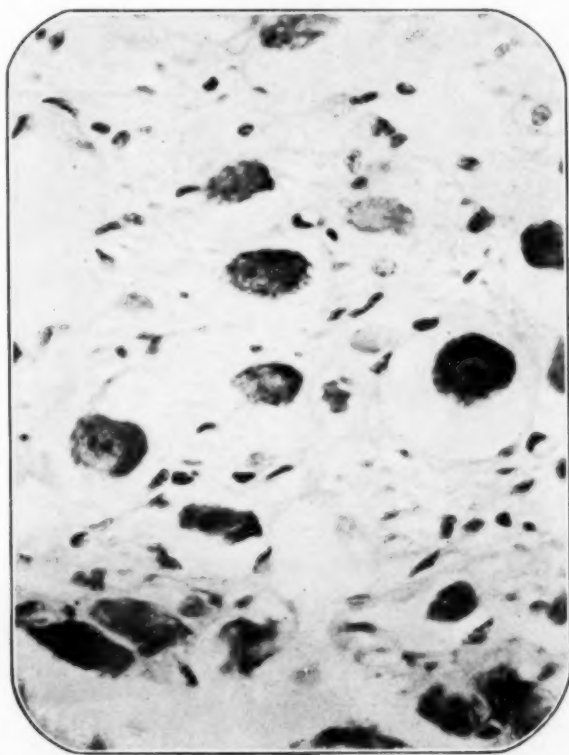


Fig. 5.—Section of geniculate ganglion of a cat in which the facial nerve had been severed at the stylomastoid foramen. Toluidin blue-erythrosin stain.

peripherally and later reaching the fifth through the greater superficial petrosal or by some other unexplained pathway within the cranial cavity. On the contrary, the clinical observations of Kidd and Ivy and Johnson support the view that the facial nerve carries muscle sensory fibers and that the trigeminal is an epicritic and protopathic nerve par excellence. There has not been offered any experimental evidence to corroborate any of these clinical observations.

The foregoing animal experiments must lead one to the recognition of certain facts. When the trigeminal sensory root is completely cut

or the ganglion thoroughly avulsed, there is a complete loss of response on the corresponding half of the face, cornea and mucous membrane of the nose and mouth to superficial stimulation with a strong and painful faradic current. However, if the sharp pointed electrodes are thrust beneath the skin into the facial muscles or on to the bone and stimulation effected, there is an unquestioned response. Further, if the facial nerve to the same side is cut, producing a definite peripheral facial paralysis, neither superficial nor deep faradization produces a response.

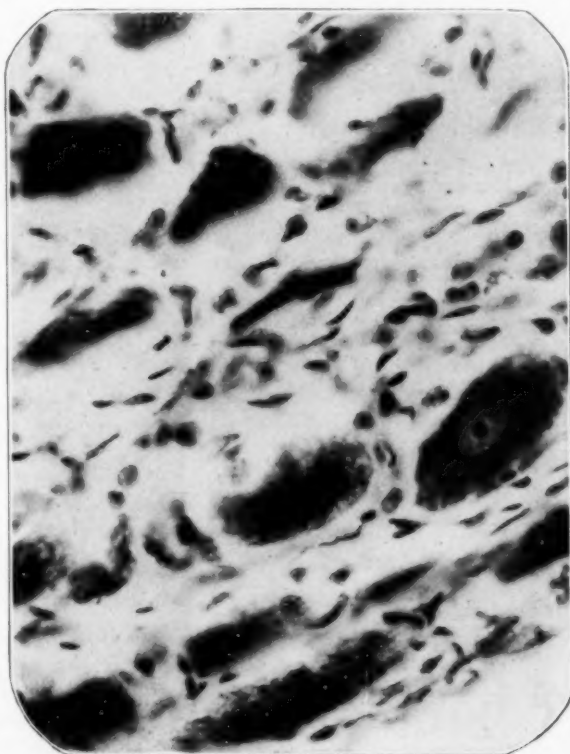


Fig. 6.—Section of geniculate ganglion of a cat in which the chorda tympani nerve had been destroyed. Toluidin blue-erythrosin stain.

This certainly suggests the presence of afferent fibers within the peripheral facial nerve supplying the muscles of the face. Further proof of this may be obtained by examining the geniculate ganglions of animals in which the facial nerve has been cut at the stylomastoid foramen. Figure 5 is a toluidin blue-erythrosin stain of such a ganglion, while Figure 6 is a like stain of the geniculate ganglion of an animal in which the chorda tympani nerve had been destroyed. The ganglion of the cut peripheral facial nerve shows a smaller number of cells with chromatolysis than does the ganglion of the cut chorda tympani. Never-

theless, in the former case chromatolytic cell changes cannot be denied. The work of Van Gehuchten and Amabilino supports these findings.

It is quite true that statements as to the presence or absence of sensation following experimental lesions in animals cannot be conclusive. On the other hand, such facts in conjunction with clinical evidence bear weight. Each of the patients on whom a trigeminal neurectomy had been performed showed a loss of superficial sensation corresponding to the accepted area of the trigeminal supply. In addition, each of the patients showed the definite presence of pressure pain sensation, and the algometer readings on the affected side were almost identical with those on the normal half of the face. When differences were present, there was always a higher reading on the side of the lesion. Radiation of the pain is absent on the side of the cut nerve, as is one and two point discrimination sensibility. Cases tested for the lacrimal reflex by pressure within the nares showed that it was present. In addition, we were quite fortunate in being able to observe one case in which there was a concomitant total loss of the fifth and seventh cranial nerves on one side and another case in which this condition was present over the ophthalmic division of the fifth nerve. In the first instance, pressure pain could not be produced with 15 kg. of pressure over any point on the right half of the face, the side of the lesion. In the second case, the same observation was made concerning the region over the forehead where the fifth and seventh nerve supply was lost.

Here, then, exists experimental and clinical evidence that muscle sensory fibers to the facial muscles are contained within the peripheral trunk of the facial nerve, the cells of which exist within the geniculate ganglion. Applying Head's theory of the sensory mechanism in the peripheral nerves to the sensory supply of the face, it would mean that the trigeminal nerve carries the afferent epicritic and protopathic impulses, while the facial nerve transmits the impulses of deep sensibility from the face.

CONCLUSIONS

1. Pressure pain sensibility in the face is retained following trigeminal neurectomy or ganglionectomy, although all superficial cutaneous sensibility is lost.
2. Afferent fibers which transmit pressure pain sensation from the face exist within the facial nerve trunk.
3. The cells of origin of these afferent fibers exist within the geniculate ganglion, and their internal prolongations pass cephalad within the nervus intermedius.
4. The facial nerve is, therefore, a mixed nerve in man, and contains a general visceral sensory component.

DISCUSSION

DR. LEWIS J. POLLOCK: I should like to ask Dr. Davis one or two questions, but before doing that I would like to call Dr. Patrick's attention to something I think we have observed together. In peripheral facial palsies, the patients were unable to feel muscle movement produced by galvanic stimulation, unless it was very painful.

I would like to ask Dr. Davis whether he had occasion to examine the pressure sense in the tongue after a section of the sensory root of the fifth, or gasserectomy. It would appear to me that if the fibers for deep sensibility are carried along with a motor nerve to the muscle which it innervates, pressure sense should be supplied to the tongue by the hypoglossal; and therefore I should expect that the deep pressure sense would not be lost in the tongue following a gasserectomy.

DR. LOYAL E. DAVIS: I did not examine the patients for the presence of deep sensibility in the tongue, but to suppose that the chorda tympani fibers carry this sensation seems to be rather far fetched. It would seem more logical to place the fibers transmitting deep sensation from the tongue in the hypoglossal nerve.

I did not report six or seven cases of early peripheral facial paralysis which I examined for the determination of muscle movements, because the patients to my mind were not intelligent enough to be able to distinguish the difference between the sensation produced by the stimulation with the electric current and the movements of the facial muscles. I feel, however, that sensation produced by muscle movements is lost with pressure pain sensibility with a lesion of the facial nerve.

AFFERENT IMPULSES OF THE TRIGEMINAL NERVE

THE INTRAMEDULLARY COURSE OF THE PAINFUL, THERMAL AND TACTILE IMPULSES *

MARGARET WILSON GERARD

CHICAGO

CONTENTS

- I. INTRODUCTION.
 - 1. The Anatomy of the Trigeminal Nerve.
 - 2. Functional Divisions of the Spinal Trigeminal Tract.
 - 3. Blood Supply for the Spinal Trigeminal Tract and Nucleus.
- II. CLINICAL DATA.
 - 1. Symptom Complex of Occlusion of the Posterior Inferior Cerebellar Artery.
 - 2. Clinical Cases of Its Occlusion.
 - 3. Cases with Other Lesions.
 - 4. Summary and Discussion of Cases.
- III. EXPERIMENTAL WORK.
 - 1. Introduction.
 - 2. Surgical Technic.
 - 3. Methods of Experimentation.
 - 4. Experimental Results.
 - 5. Comment.
- IV. CONCLUSIONS.

I. INTRODUCTION

ANATOMY OF THE TRIGEMINAL NERVE

The trigeminal nerve is composed of a large sensory division whose unipolar cells are in the Gasserian ganglion, and a small motor division distributed entirely through the mandibular branch of the nerve. The skin of the face and the mucous membrane of the mouth, tongue, and nose are supplied by pain, tactile, and thermal fibers which pass into all three branches of the trigeminal nerve; these are the ophthalmic, maxillary and mandibular nerves. The cornea differs from other parts of the face, in that only painful sensations may be elicited by stimulation of this region (Schäfer,¹ 1900). Sensory fibers also accompany the motor root into the brain stem, their unipolar cells of origin forming the mesencephalic nucleus, which is an unusual location for sensory cells. These fibers are believed to be proprioceptive and to supply

* Contribution No. 98 from the anatomic and physiologic laboratories, Northwestern University Medical School.

1. Schäfer, E. A.: Text-Book of Physiology, London, Longmans, Green & Co. 2:987, 1900.

the muscles innervated by the motor division of the trigeminal nerve (Willems,² 1911, Allen,³ 1919). The main sensory root carries the usual cutaneous sensations.

In cross section, the trigeminal nerve in the cat was seen to consist of fibers varying from unmyelinated fibers of 1.5 microns to the largest myelinated fibers of 16 microns. These latter belonged to the motor root and were always found on the dorsal surface of the nerve. There were very few of them, only 46 and 42 in two nerves counted,⁴ the majority of the motor fibers being between 10.8 and 11.7 microns in diameter. In two nerves 370 and 390 fibers of this size were found. Many of these, however, must be considered as sensory rather than motor since they occupied a more ventral position than any of the motor fibers.

The majority of the sensory fibers ranged from 5.3 to 8 microns in diameter and were scattered evenly throughout the sensory part of the nerve. In different specimens 2480 and 2459 of these fibers were counted. Intermediate fibers of 3.7 to 4 microns numbered 274 and 204 in the two different nerves, and fibers smaller than 3 microns appeared in equal numbers. In the pyridin silver preparations several bundles of unmyelinated fibers (392 and 400 in two different nerves) were seen scattered between the larger fibers. The small number of unmyelinated fibers in the trigeminal nerve is in marked contrast to the conditions in most other nerves, which contain numerous unmyelinated fibers (Kock,⁵ 1916).

In the cat the nerve is directed caudad and pierces the pons in the rostral ventrolateral region, and makes a slight curve dorsad (Fig. 1). The motor fibers separate almost immediately from the others and divide into several small bundles which pierce the pontine fibers and pass dorsad to the motor nucleus. The sensory division continues 0.5 to 1 millimeter caudad, and then breaks into a main sensory portion which passes dorsad to the main sensory nucleus, and a spinal tract which extends caudad into the medulla. Cajal,⁶ 1896, in a very com-

2. Willems, E.: Les noyaux masticateurs et mésencéphaliques du trijumeau, *Le Névralgiste* **12**:7, 1911.

3. Allen, W. F.: Application of the Marchi Method to the Study of the Radix Mesencephalica Trigemini in the Guinea-Pig, *J. Comp. Neurol.* **30**: 169, 1919.

4. The fiber counts of two or three different nerves are presented always in the same sequence—those from nerve A being given first, etc. The counts were made by enumerating the fibers in successive fields under the microscope, the stage being arranged to move in such manner that the lines of all series were parallel.

5. Kock, S. L.: The Structure of the Third, Fourth, Fifth, Sixth, Ninth, Eleventh and Twelfth Cranial Nerves, *J. Comp. Neurol.* **26**:541, 1916.

6. Cajal, S. R. y: *Beitrag zum Studien der Medulla Oblongata*, 1896.

prehensive description of the trigeminal nerve, claimed that the two sensory parts are formed from the sensory division by the splitting of each individual fiber in it, into a small branch passing to the main sensory nucleus and a larger branch passing to the spinal nucleus. In sections of brains of new-born rats and rabbits, prepared by the Golgi silver impregnation method, he was able to see this bifurcation. Since, with this method, all the fibers are never impregnated, it would be

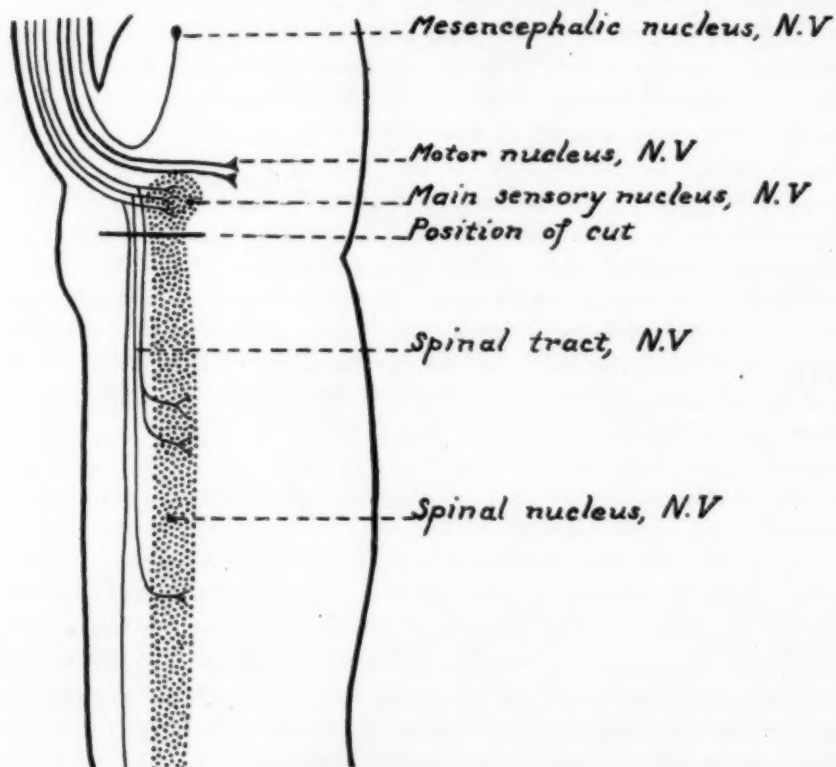


Fig. 1.—Diagram of a longitudinal section of the medulla, showing the central connections of the fifth nerve and the position of the experimental lesion.

impossible to determine whether or not every fiber bifurcates. Indeed, Kölliker,⁷ asserted that all the fibers do not do so, while Held,⁸ confirmed Cajal's description. That many of the fibers do bifurcate is evident in the pyridin silver preparations which we have examined, though it is not certain that all do. Actual bifurcations may be seen in

7. Kölliker, A.: Der feinere Bau des verlängerten Markes, *Anat. Anz.* 6: 427, 1891.

8. Held, H.: Die Endungsweise der sensiblen Nerven im Gehirn, *Arch. f. Anat. u. Phys.*, 1892, p. 33.

many cases, and there is a noticeable increase in the total number of fibers as the nerve approaches the point of separation of the two divisions. This increase is mainly in the smaller fibers which are seen to pass to the main sensory nucleus. It may be noted that in no case are any of the unmyelinated, or the small myelinated, fibers seen to branch, indicating that these may, perhaps, pass entire into the spinal tract.

The descending or spinal tract forms, in the brain stem, a half-moon shaped bundle which caps the peripheral edge of the spinal trigeminal nucleus. In this bundle one can distinguish a superficial layer composed of vertical fibers only, and a deeper layer of vertical interlaced with horizontal fibers. The latter fibers are terminations and collaterals on their way to the spinal nucleus. Within the nucleus the fibers form a diffuse network between the individual cells. Kölliker,⁷ believed that, besides the endings in the substantia gelatinosa, there were collaterals which passed to the motor nuclei of the trigeminal, facial and hypoglossal nerves. Obersteiner,⁹ 1912, confirmed this observation, though Cajal⁶ 1896, had strongly denied it. In 1902, Breuer and Marburg¹⁰ described a bundle of fibers in the medial part of the tract, which they named "fibrae concomitantes", and which passed, in their opinion, through the spinal trigeminal nucleus to reach the nucleus solitarius, in which the tract terminated. Wallenberg,¹¹ 1904, again mentioned this bundle and suggested that it carried taste fibers from the mucous membrane of the mouth.

Cajal,⁶ in 1896, claimed to have traced the spinal fifth tract to a region just below the bifurcation of the pyramids. Wallenberg,¹² found in Marchi preparations from cats and rabbits whose fifth nerve had been cut, evidence of degeneration as low as the first cervical segment. Kljatschin,¹³ 1897, with a similar technic, followed the degeneration to the second cervical segment. Other investigators, Pomatowsky,¹⁴ in 1892, and Obersteiner⁹ in 1912, asserted that the tract extended to

9. Obersteiner, H.: Anleitung beim Studien des Baues der nervösen Centralorgane in gesunden und kranken Zustände, Leipzig, 1912, p. 533.

10. Breuer, R., and Marburg, O.: Zur Klinik und Pathologie der apoplectiformen Bulbarparalyse, Arb. a. d. Neurol. Inst. a. d. Univ. Wien 9:181, 1902.

11. Wallenberg, A.: Anatomischer Befund in einen als "Blutung in die rechte Brückenhälfte usw. aus dem Ram. Central. Arter. radicular N. facialis dextri" geschilderten Fälle, Deutsch. Ztschr. f. Nervenheilk. 27:436, 1904.

12. Wallenberg, A.: Die secundäre Bahn des sensiblen Trigeminus, Anat. Anz. 12:95, 1896.

13. Kljatschin, G.: Experimentelle Untersuchungen über den Ursprung des N. Trigeminus, Neurol. Centralbl. 16:204, 1897.

14. Pomatowsky, A.: Ueber die Trigeminus-Wurtzel im Gehirne des Menschen, Arb. a. d. Inst. f. Anat. u. Phys. d. centr. Nervensyst., Wien 1:98.

the second or third cervical segments. Gudden¹⁵ in 1892, after examining a calf with unilateral trigeminal aplasia, concluded that the spinal tract extended to the fifth cervical segment. Dejerine¹⁶ in 1914, considered the fourth cervical segment as the termination of the tract. In our preparations by the Pal-Weigert and pyridin silver methods, from cats in which one fifth nerve had been cut and allowed to degenerate, we found no evidence of degeneration below the upper level of the second cervical segment. This is in agreement with the evidence of Kljatschin, who based his conclusions upon Marchi preparations.

In examining the cross sections at various levels of the brain stem of the cat and of man, we found that in the lower levels of the tract there was a greater proportion of small myelinated fibers than in the upper levels, and at the lowest limits there was an actual increase in the number of unmyelinated fibers. As seen in cross section, the fibers of different sizes were evenly distributed, but were united into bundles of various sizes by the horizontal fibers, which had changed their direction to end in relation with the cells of the spinal fifth nucleus.

The largest fibers in the spinal fifth tract of the cat measured 9.9 to 10.1 microns in diameter. These were not very numerous at any point and gradually decreased in number as the tract descended. In two different brain-stems stained with the Pal-Weigert and pyridin silver methods, 149 and 157 fibers respectively were counted in the region of the superior olive. At the upper level of the inferior olive these fibers had decreased in number to 99 and 117, and a third preparation contained 129 in this region. At the lower level of the inferior olive 34, 15, and 27 were found, while at the decussation of the pyramids, there were 17, 8, and 14. In lower sections no fibers of this size were found.

Fibers of 5.3 and 8 microns in diameter were more numerous than the larger fibers and numbered 893 and 921 at the superior olive; 713, 718, and 697 at the upper level of the inferior olive; 612, 679, and 631 at the lower level of the inferior olive; and 312, 298, and 287 in the region of the decussation of the pyramids. All of these disappear above the upper level of the first cervical segment.

Fibers of 3.7 to 4.8 microns were found to be very numerous; 1102, and 1080 in the superior olivary region; 853, 839, and 872 at the upper level of the inferior olive; 704, 622, and 661 at the lower level of the olive; 417, 423, and 432 at the decussation of the pyramids; and 210, 197, and 184 in the upper region of the first cervical segment.

15. Gudden, H.: Beitrag zur Kenntniss der Wurzeln des Trigeminus Nerven, *Allg. Ztschr. f. Psych.* 48:16, 1892.

16. Dejerine, J.: *Sémiologie des affections du système nerveux* 2:800, 1914.

Myelinated fibers smaller than the last were equally numerous; 1161 and 1143 at the superior olive; 1109, 1134, and 1124 at the upper level of the inferior olive; 495, 472 and 392 at the decussation of the pyramids; and 149, 139 and 153 at the upper level of the first cervical segment.

The unmyelinated fibers in the pyridin silver preparations numbered 506 at the superior olive, 443 at the upper level of the inferior olive, 408 at its lower level, 392 at the decussation of the pyramids, and 502 at the upper level of the first cervical segment.

In the human brain-stem, the same relative proportion of the various sizes of fibers was found, although the fibers in each group averaged slightly larger than those of the cat; the largest being 11.3 microns instead of 10.1 microns.

To sum up this description, there is a decrease in the size and number of the fibers in the path as it descends; the larger fibers drop out entirely, as do some of the smaller ones, but many of the myelinated and unmyelinated fibers descend to the end of the tract. This indicates either that the larger fibers terminate in the upper levels of the tract or that, as a result of giving off collaterals on the way, they continue to the lower levels as smaller fibers. The actual increase in the number of unmyelinated fibers may be due to the loss of the myelin sheaths of the smaller fibers as they reach the lower levels, or, possibly, to the upward continuation into the spinal fifth tract of fibers from the tract of Lissauer, which is largely composed of unmyelinated fibers (Ranson,¹⁷ 1913). Since there is no line of demarcation between the tract of Lissauer in the upper cervical segment of the cord and the lower level of the spinal fifth tract, it is possible that those earlier observers who did not use Marchi technic confused these two fiber bundles, with a consequent disagreement on the actual boundary.

FUNCTIONAL DIVISIONS OF THE SPINAL TRIGEMINAL TRACT

The different branches of the fifth nerve seem to retain their identity within the spinal tract. Bregmann,¹⁸ 1892, after partially cutting the sensory root, observed a disturbance of painful sensibility in the ophthalmic division of the nerve and a degeneration in the ventral part of the tract. When the degeneration was in the dorsal part of the tract, sensibility in the maxillary and mandibular regions was involved. Obersteiner⁹ in 1912, described a similar distribution and further localized the fibers of the maxillary division in the medial part of the tract.

17. Ranson, S. W.: The Course within the Spinal Cord of the Nonmedullated Fibers of the Dorsal Roots: A Study of Lissauer's Tract in the Cat, *J. Comp. Neurol.* **23**:259, 1913.

18. Bregmann, E.: Ueber experimentelle aufsteigende Degeneration motorischen und sensiblen Hirnnerven, *Arb. a. d. Inst. f. Anat. u. Phys. d. centr. Nervensyst.*, Wien **1**:73.

Other investigators have suggested that the different branches of the nerve also terminated at different levels of the tract. Solder¹⁹ in 1899, and Schlesinger²⁰ in 1902, believed that the frontal branch of the ophthalmic nerve extended the whole length of the spinal tract, the mandibular ended just above, the maxillary still higher, and the nasociliary branch of the ophthalmic extended only into the highest part of the tract. This arrangement was indicated in cases of syringomyelia, with a lesion proceeding rostrad through the medulla, in which the analgesia which resulted from the disease progressed in the form of narrowing circles from the periphery of the face, until only the nose and the medial side of the eye were left intact in the last stages of the disease. A case described by Woods²¹ in 1913, showed a similar area of analgesia surrounding the nose and eye.

Kutner and Kramer,²² 1907, and Wallenberg,¹¹ 1904, suggested a slightly different arrangement. According to them, the whole ophthalmic division extended to the lowest level of the tract, the maxillary not so far, and the mandibular division ended near the top. They also stated that the fibers from the lingual and buccal mucous membranes occupied the dorsal part of the spinal tract, while the fibers from the conjunctiva and the nasal mucosa were situated in the ventral part of the tract. In 1914, Dejerine,¹⁶ claimed that the area of analgesia centered around the nose and mouth.

In general, then, it may be said that the fibers supplying the most peripheral part of the face extend further down the spinal tract, while those supplying the central area terminate nearer to the beginning. It may also be said that those which extend further down the tract probably run ventrad to those which terminate at a higher level.

BLOOD SUPPLY FOR THE SPINAL FIFTH TRACT AND NUCLEUS

For the purpose of this investigation a consideration of the blood supply of the lateral area of the medulla, through which the spinal tract of the fifth nerve passes, is of prime importance. This area is supplied principally by the posterior inferior cerebellar artery. According to Stopford,²³ 1916, this is the largest branch of the vertebral

19. Von Solder, F.: Der segmentale Begrenzungstypus bei Hautanaesthesien am Kopfe, insbesondere in Fälle von Syringomyelie, *Jahrb. f. Psychiat.* **18**: 458, 1899.

20. Schlesinger, H.: Die Syringomyelie, 1902, p. 162.

21. Woods, A. H.: Segmental Distribution of the Spinal Root and Nucleus of the Trigeminal Nerve, *J. Nerv. & Ment. Dis.* **40**:91, 1913.

22. Kutner, R., and Kramer, F.: Sensibilitätsstörungen bei akuten und chronischen Bulbärerkrankungen, *Arch. f. Psychiat.* **42**:1002, 1907.

23. Stopford, J. S.: The Arteries of the Pons and Medulla Oblongata, *J. Anat. & Physiol.* **50**:131 and 254, 1916.

artery, and arises from its side at the lower end of the olive. "After curving round the lower border of the olive, it ascends in the neighborhood of the posterior lateral sulcus, usually posterior to the fila of the vagus and glossopharyngeal nerves, almost to the lower border of the pons, where it changes its direction and forms a loop with its convexity toward the pons. It now proceeds downwards, with a slight inclination toward the midline, on the restiform body and the other inferolateral boundaries of the fourth ventricle, to just below the calamus scriptorius, where it turns outward on to the vallecule to divide into its fully described lateral and medial branches, for the supply of the inferior surface of the cerebellum."

In the brain stem, Stopford found that the injected area was limited ventrally by the inferior olive, laterally by the tegmento-olivary tract, and medially by the fibers of the hypoglossal nerve. This area would therefore include the following structures:

1. Spino-thalamic tract.
2. Rubro-spinal tract.
3. Olivo-cerebellar fibers as they pass to the inferior cerebellar peduncle.
4. Dorsal vago-glossopharyngeal nucleus of the emerging fibers of the vagus and glossopharyngeal nerves.
5. Nucleus ambiguus.
6. Nucleus and tractus spinalis of the trigeminal nerve.
7. Ventral part of the inferior cerebellar peduncle.

We have found no record of experimental evidence which indicates a differentiation in the functions of the main sensory nucleus and the spinal nucleus. On the other hand, there have been many clinical cases recorded in the literature which suggest this possibility. Cases of occlusion of the posterior inferior cerebellar artery, strongly suggest that the pain and temperature fibers of the fifth cranial nerve terminate within the spinal nucleus of that nerve, while the fibers carrying tactile sensations terminate more rostrad in the main sensory nucleus. Cases of syringomyelia or of hemorrhage into the medulla which caused destruction of one or the other nucleus gave similar results. These cases have not as yet been collected, and the evidence which they offer has not been focused on the problem of sensory conduction in the trigeminal nerve. The investigation which I am here reporting represents an endeavor to assemble the clinical data and to secure experimental evidence on the question of such a differentiation.

II. CLINICAL DATA

SYMPTOM-COMPLEX OF OCCLUSION OF THE POSTERIOR INFERIOR CEREBELLAR ARTERY

The symptoms which occur after occlusion of the posterior inferior cerebellar artery are remarkably constant and, in order to simplify the

presentation of the clinical evidence, they may be summarized in accordance with Gordinier:²⁴ 1911:

1. Sudden onset, usually without loss of, or disturbance in consciousness.
2. Diminution or loss of sensibility to pain and temperature in the area of distribution of the fifth nerve on the side of the lesion.
3. Diminution or loss of sensibility to pain and temperature in the limbs of the side opposite to the lesion, very rarely also, in the side of the face opposite the lesion. (This indicates an involvement of the secondary trigeminal path).
4. No paralysis or paresis of the muscles innervated by the trigeminal nerve.
5. Spontaneous pain or some form of paresthesia in the area of disturbed objective sensibility.
6. Tactile sensibility intact in all parts.
7. Sensibility of position usually intact.
8. Rarely a zone of intact sensibility in the region of the neck, between the area of disturbed sensibility in the face on the one side and that of the limbs on the other.
9. Tendency to fall or sway toward the side of the lesion; and for the head to drop forward toward the same side.
10. Bilateral nystagmus, more intense when the eyes are directed toward the side of the lesion.
11. Menière's syndrome of vertigo, revolving vertigo, auditory hallucinations, vomiting, and deafness on the side of the lesion.
12. Paralysis of the muscles of deglutition on the side of the lesion, with impaired sensibility of the pharynx.
13. Paralysis of the soft palate and larynx on the side of the lesion; vocal cords immobile in a cadaveric position; the voice hoarse and the speech merely a whisper.
14. The tongue, rarely, is a little weak on the side of the lesion, but the weakness usually soon passes away.
15. Taste may occasionally be lost on the anterior two-thirds of the tongue.
16. The facial and abducens nerves are not involved in the lesion.
17. Small pupil, ptosis, narrow palpebral fissure, and retraction of the eyeball on the side of the lesion.
18. Loss of sweating of the face on the side of, or on the side opposite to the lesion.
19. Persistent hiccup.
20. The pulse may be rapid (from paralysis of the vagus) or slow (from irritation of the vagus).

24. Gordinier, H. C.: Occlusion of the Posterior Inferior Cerebellar Artery, a Definite Symptom Complex, *Albany M. Ann.* **32**:585, 1911.

These symptoms are so typically constant, that they may be considered as a syndrome. For this reason, it will not be necessary to discuss the symptoms of the following cases at length, and those symptoms alone will be detailed which bear directly on the sensory defects in the trigeminal area.

Unfortunately, a clinical examination is not always as complete nor as carefully executed as one might desire, so that a number of the cases here reported lack adequate detail, and are of value only to confirm those which are more complete. For example, the clinician reports a "disturbance" in temperature or pain sensibility but does not state the manner of variation from normal. In some of the cases there was no mention of the integrity of certain sensibilities, and we must conclude that such sensibilities were not examined. In some cases diagnosed as "probable occlusion of the posterior inferior cerebellar artery," the sensory disturbances of the face and of the body were on the same side; this indicates involvement of the secondary paths of the fifth nerve rather than of the primary path. These cases, therefore, were either incorrectly diagnosed, or were so atypical that no conclusions on the distribution of the fibers of the fifth nerve may be drawn; they have consequently been omitted.

CLINICAL CASES OF OCCLUSION OF THE POSTERIOR INFERIOR CEREBELLAR ARTERY

CASE 1.—The first case on record is that of Senator,²⁵ 1881. He tested for painful sensibility with a pin or needle prick, and with cotton wool for tactile sensibility. Tests for temperature were not recorded. Examination disclosed an area of total analgesia which included the left side of the forehead, nose, cheek, lips and chin, just to the midline; the sensibility to pain on the whole right side of the face remained intact. The tactile sensibility of the left side, on the contrary, was, when compared with the right side, little, if at all, impaired.

The necropsy disclosed a thrombus in the left vertebral artery, which extended into the posterior inferior cerebellar branch, and into the anterior spinal artery, and occluded them both. The resultant necrosis in the medulla was spindle shaped in cross-section and stretched from the middle of the olive to the lowest of the hypoglossal rootlets. It included among other structures (the restiform body, the border of the cuneate fasciculus, the motor nucleus of the vagus, part of the vagus fibers, part of the inferior olive, the accessory olivary nuclei, and the roots of the hypoglossal nerve), the spinal root of the trigeminal nerve, which was therefore destroyed, while the main sensory and motor nuclei of the trigeminal nerve, which were above the lesion, had remained intact.

CASE 2.—Another case was reported in 1881 by Remak.²⁶ The symptoms were typically those of occlusion of the posterior inferior cerebellar artery,

25. Senator, H.: Apoplektische Bulbärparalyse mit wechselständiger Empfindungslähmung, *Arch. f. Psychiat.* **11**:713, 1881.

26. Remak, R.: Krankenvorstellung eines Falles vom Hemianaesthesia alterans, *Berl. klin. Wchnschr.* **18**:300, 1881.

although there was no necropsy, and included, an analgesia on the right side of the face, which was particularly marked on the forehead and eyeball, and was accompanied by persistent spontaneous pain in the same regions. The activity of the motor fibers of the trigeminal nerve was entirely normal.

CASE 3.—In 1883, Senator²⁷ reported a case with necropsy. He tested for painful sensibility with a needle prick, but failed to mention his method of tactile examination. Temperature sensibility was not mentioned. The sensation of touch was normal on both sides of the face while needle prick on the left cheek, nose and inside of the nostril produced only tactile sensations.

At the necropsy a thrombus was found in the left vertebral artery. It occluded the lumen for a considerable distance, and also the opening of the posterior inferior cerebellar artery. The resulting lesion in the medulla spared the main sensory and motor nuclei of the trigeminal nerve, but included the descending or spinal root of this nerve, together with the vagal roots and nucleus, the restiform body, the fasciculus solitarius, the nucleus and roots of the hypoglossal nerve, and the cochlear nuclei and part of the olive.

CASE 4.—Wallenburg²⁸ announced the next case in 1895, though the necropsy report did not appear until 1901.²⁹ He did not detail his methods of testing the various sensibilities, but reported anesthesia to cold, painful and electrical cutaneous stimuli, on the whole of the left side of the face.

The necropsy in this case revealed an obturating thrombus in the left posterior inferior cerebellar artery. There was also a parietal thrombus in the right posterior inferior cerebellar artery, which only slightly narrowed the lumen. Microscopic examination of the medulla disclosed an anemic necrosis which included the ventral two-thirds of the spinal root and nucleus of the trigeminal nerve.

CASE 5.—Mann,³⁰ 1892, reported a case which he termed encephalomalacia medullae oblongatae. There was no necropsy to determine the etiology, but the symptoms were similar to those which follow occlusion of the posterior inferior cerebellar artery. An area of the right side of the face which extended from the vertex capitis to the chin and from the anterior edge of the ear to the midline, showed a marked reduction in pain, temperature and electrocutaneous sensibility and also a subjective burning pain. The mucous membrane of the right cheek also showed a reduction in painful sensibility. Tactile sensibility on the right side of the face, on the other hand, was entirely normal, as was all sensibility on the left side of the face.

CASE 6.—In 1897, Hun³¹ published an excellent, detailed discussion of a case which had come under his observation. He tested for painful sensibility with a pin prick, and for thermal sensibility with test tubes filled with hot or cold water. Examination of the patient revealed that the left side of the

27. Senator, H.: Zur Diagnostik der Herderkrankungen in der Brücke und dem verlängerten Mark, *Arch. f. Psychiat.* **14**:643, 1883.

28. Wallenberg, A.: Acute Bulbäraffektion (Embolie der Art. Cerebellaris Post. Inf. Sinistra?), *Arch. f. Psychiat.* **27**:504, 1895.

29. Wallenberg, A.: Anatomischer Befund in einem als "akute Bulbäraffektion (Embolie der Art. Cerebellaris Post. Inf. Sinistra?)" beschriebenen Falle, *Arch. f. Psychiat.* **34**:923, 1901.

30. Mann, L.: Casuistischer Beitrag zur Lehre von central entstehenden Schmerz, *Berl. klin. Wchnschr.* **29**:244, 1892.

31. Hun, H.: Analgesia, Thermic Anaesthesia and Ataxia, *New York M. J.* **65**:613, 1897.

face and tongue, the inside of the left nostril, the right arm, right leg and right side of the body were entirely normal in tactile sensibility but were absolutely insensitive to pain and to differences in temperature. There were: decreased sweating on the left side of the face, a slight ptosis of the left eyelid, and, when the disease progressed, an appearance and gradual spread of left facial paralysis. All the muscles of mastication on both sides were spared which proved that the motor nucleus of the trigeminal was intact. Later, a partial sensitivity to painful stimuli returned in the body regions, but not on the face.

The examination of the brain at the necropsy was performed by Van Gieson, who reported that areas of softening existed on the left side, in the medulla, lower pons, and cerebellum, and that no lesions were found elsewhere. Histologic examination showed that the destruction involved the spinal tract and nucleus of the fifth nerve (as well as: the dorsal spinocerebellar tract; the column of Gowers; the fibers which pass between the cerebellum and inferior olive; part of the gray reticular formation; the motor nuclei of the glossopharyngeal and vagus nerves; and a very small part of the inferior olive), but did not include its main sensory and motor nuclei. The degeneration of the spinal fifth tract was complete, and extended to the upper part of the first cervical segment which Van Gieson claimed to be the lowest level of the tract.

CASE 7.—Wallenberg,³² 1901, reported a case which bore the earmarks of occlusion of the posterior inferior cerebellar artery, though the case did not come to necropsy (the patient was still living when the report was made). He found the usual hypalgesia and hypothermesthesia in the region supplied by all three branches of the right trigeminal nerve, which included the mucous membrane of the mouth and tongue. The areas of greatest disturbance were: the right temple, the right eye, the bridge of the nose, the slightest area about the angle of the jaw, and the ears and chin. Wallenberg mentioned a disturbance in tactile sensibility on the left side of the body, but made no reference to touch in relation to the face. It seems legitimate to conclude that, had there been any disturbance in tactile sensibility of the face, he would have mentioned it also.

CASES 8 AND 9.—In 1902, Breuer and Marburg¹⁰ reported two cases with necropsies. In the first one, the clinical examination revealed no disturbance on the right side of the face nor of the motor functions or tactile sensibility on the left. The region of the left side of the face supplied by the third branch of the fifth nerve, however, was insensitive to painful stimuli and was also the seat of a subjective pain.

At necropsy, a thrombus, which entirely occluded the opening of the posterior inferior cerebellar artery, was found in the left vertebral artery. Marchi preparations of the medulla showed areas of degeneration which included: the left spinal fifth tract below the level of the upper border of the decussation of the lemnisci; a bundle lateral to the posterior longitudinal bundle (the central fifth tract of Wallinger); and a bundle dorsal to the medial lemniscus (the ventral Haubenfeld of Spitzen, which is also a central fifth path).

The report of the second case was rather incomplete. There was no disturbance in motor activity of any part of the body, the sensibility to painful

32. Wallenberg, A.: Klinische Beiträge zur Diagnostik akuter Herd-erkrankungen des verlängerten Markes und der Brücke, Deutsch. Ztschr. f. Nervenheilk. 19:225, 1901.

and tactile stimuli was intact on both sides of the face and the right side of the face was also sensitive to thermal stimuli. But the left side of the face did not respond to cold.

The necropsy disclosed a thrombus in the left vertebral artery. The resultant lesion in the medulla involved a small part of the left trigeminal tract in its whole length; which particular part, was not specified.

CASE 10.—Rossolimo,³³ in 1903, described a patient (Case 5 of his report) whose symptoms were typically those of occlusion of the posterior inferior cerebellar artery, and though unconfirmed by necropsy, the case may be regarded as such. The patient showed marked disturbances of pain and temperature sensation in all areas innervated by branches of the left trigeminal nerve. In that portion of this area supplied by the maxillary division, there was also a subjective neuralgia. The right half of the body showed no disturbance in pain and temperature.

CASE 11.—In 1903, Mai³⁴ also reported a case of this type. An area of the right side of the face, reaching from the midline to a curve connecting the outer corner of the eye, the anterior part of the ear, and the corner of the mouth, and from the upper lip to the vertex capitis, was insensitive to pain and thermal stimuli. Tactile sensibility was absolutely normal over the whole body.

The necropsy disclosed a thrombus in the right vertebral artery, which partially occluded it and completely occluded the posterior inferior cerebellar artery. The resulting anemic necrosis in the right medulla included, (besides a small part of the olive, the lateral nucleus, the nucleus ambiguus and the internal and external arcuate fibers), the ventral two-thirds of the spinal fifth tract and its nucleus.

CASES 12 AND 13.—Müller,³⁵ 1906, reported two cases which were perfectly typical, though there were no necropsies. In the first case, the left side of the face showed marked hypalgesia and hypothermesthesia. The disturbance was most marked in the region of distribution of the first branch of the fifth nerve, and did not include the mucous membrane of the mouth and tongue. All forms of sensations of the right side of the face were undisturbed, as was also tactile sensibility of the left side of the face.

In the second case there was a similar hypalgesia and hypothermesthesia which involved, however, the right side of the face. In this case, again, the most marked disturbances were in the region of distribution of the ophthalmic division of the fifth nerve. There was, in addition, a continuous subjective sensation of warmth on the right side of the face. Tactile sensibility was entirely intact on this side of the face and all sensibility was normal on the left side of the face.

CASE 14.—A case with fatal termination and necropsy twelve days after the onset of the symptoms, was reported in 1907 by Thomas,³⁶ before the American Neurological Association. From the onset, there was subjective pain and dis-

33. Rossolimo, G.: Thermoanästhesie und Analgesie als Symptomen von Herderkrankung des Hirnstammes, *Deutsch. Ztschr. f. Nerven.* **23**:241, 1903.

34. Mai, E.: Ueber gekreuzte Lähmung des Kältsinnes, *Arch. f. Psychiat. u. Nerven.* **38**:182, 1903.

35. Müller, E.: Ueber ein eigenartiges scheinbar typisches Symptomenbild bei apoplektiformer Bulbarlähmung, *Deutsch. Ztschr. f. Nerven.* **31**:452, 1906.

36. Thomas, H. M.: Symptoms Following the Occlusion of the Posterior Inferior Cerebellar Artery, *J. Nerv. & Ment. Dis.* **34**:48, 1907.

turbance of pain and temperature sensibility on the right side of the face. This region was also completely dry, as the result of a complete adiaphoresis which accompanied the other symptoms.

The necropsy disclosed a thrombus in the right vertebral artery, which extended into the posterior inferior cerebellar artery. Thomas did not find any marked microscopic lesions in the medulla, so could not describe the structures which were involved.

CASE 15.—In 1908, Mauss³⁷ reported a case which showed the symptoms typical of occlusion of the posterior inferior cerebellar artery. He had no necropsy to check his diagnosis. Painful sensibility of the whole left side of the face, particularly on the forehead and cheek, was markedly diminished. Hot and cold sensibilities were diminished in the whole of the left trigeminal area, whereas tactile sensibility in this region showed no variation from the normal.

CASE 16.—Wilson,³⁸ 1909, reported, before the Royal Society of London, a case showing the same typical syndrome. The symptoms were: loss of pain sensibility over all of the left side of the face and the left eyeball; painful stimuli, such as the prick of a pin, were felt as simple pressure; loss of cutaneous pain sensibility of the left side of the mouth, tongue, palate, fauces, uvula, and pharynx; loss of sensibility to all degrees of heat and cold on the left side of the face, and anhidrosis and vasomotor disturbances in the same region. Tactile sensibility and localization of touch were intact on both sides of the face, as was the motor control of the muscles innervated through the motor root of the fifth nerve.

CASE 17.—Harris,³⁹ 1910, also reported a case before the Royal Society of Medicine of London. The patient complained of a severe neuralgia of the left side of the face, which was particularly localized over the malar bone, above the left temple, and, at first, on the left side of the nose. Examination showed an analgesia and athermesthesia over the whole left side of the face, but no disturbance of tactile sensibility on either side. This case may be diagnosed as occlusion of the posterior inferior cerebellar artery notwithstanding the lack of a necropsy, as the typical syndrome which follows this lesion was observed.

CASE 18.—In the same year, 1910, Ludin⁴⁰ described a case of thrombosis of the left vertebral artery, which had come to necropsy. Examination disclosed an analgesia and athermesthesia of the left side of the face and a slight disturbance of pain and temperature sensibility on the right side of the forehead. Tactile sensibility over the whole body was normal, as was motor control (the author does not mention the muscles of mastication in particular, so they were undoubtedly capable of function).

The necropsy disclosed, in the left vertebral artery, a thrombus which occluded the opening of its posterior inferior cerebellar branch. Histologic

37. Mauss, T.: *Klinische Beiträge zur Diagnostik Bulbäre Herderkrankungen*, Deutsch. Ztschr. f. Nervenheilk. **34**:398, 1908.

38. Wilson, S. A. K.: A Case of Thrombosis of the Left Posterior Inferior Cerebellar Artery, *Proc. Roy. Soc. Med., Neurol. Sect.* **2**:52, Pt. 2, 1909.

39. Harris, W.: A Case of Thrombosis of the Left Posterior Inferior Cerebellar Artery Followed by Severe Trigeminal Neuralgia in the Analgesic Facial Area, *Proc. Roy. Soc. Med., Neurol. Sec.* **3**:81, Part 2, 1910.

40. Ludin, M.: Ueber Thrombose der Arteria vertebralis, *Deutsch. Ztschr. f. Nervenheilk.* **40**:380, 1910.

examination of the medulla revealed a lesion at the level of the middle third of the olive, which included: the formatio reticularis, the nucleus ambiguus, the spinocerebellar, spinotectal and spinothalamic tracts, a small part of the restiform body, the substantia gelatinosa Rolandi, and the spinal root of the fifth nerve.

The symptoms in this case were somewhat atypical, in that there was a disturbance in pain and temperature sensibilities on the side of the forehead opposite to the lesion. It may be noted that Ludin mentions only a "disturbance" of these sensibilities on the right, rather than a lack of them such as existed on the left side. It is possible that this disturbance was due to involvement of some secondary trigeminal fibers as they passed through the reticular formation from right to left, as the whole reticular formation was evidently involved in the lesion.

CASES 19, 20, AND 21.—In 1911, Gordinier⁴¹ reported three cases which, from the clinical picture, he diagnosed as occlusion of the posterior inferior cerebellar artery, though no necropsies were obtained. The first case was very incomplete, mention being made only of tactile sensibility, which was normal upon both sides of the face. The second case showed complete loss of pain and temperature sensibilities over the whole of the left side of the face; the tactile sensibility of that side was entirely normal. The third case showed, in addition to a distinct reduction in pain and temperature sensibilities over the whole of the right trigeminal area, a marked anhidrosis of the right side of the face. Tactile sensibility was intact over the whole of the body.

CASE 22.—In the same year, 1911, Head and Holmes⁴² described a case which they called occlusion of the posterior inferior cerebellar artery. They used a prick of calibrated intensity to test pain sensibility, cotton wool to test tactile sensibility, and metal tubes (silver, 1.25 cm. in diameter) filled with water at various temperatures to test thermal sensibility. Examination revealed an insensibility to prick over the whole left side of the face. The threshold stimuli for pressure-pain, tactile, and thermal sensations were normal and equal on the two halves of the face. The patient complained, however, that all temperature seemed "duller" on the left side of the face than on the right.

CASE 23.—Courtney⁴³ reported a case in 1912 which, from its typical syndrome, he believed to be due to thrombosis of the left posterior inferior cerebellar artery. Tactile sensibility was well preserved on the right side of the face, while pain was markedly blunted. Heat was perceived in part, as such, and cold, when felt at all, produced a sensation of warmth.

CASE 24.—Salmon,⁴⁴ 1912, reported a case of occlusion of the posterior inferior cerebellar artery with typical symptoms. He observed: complete insensibility to thermal, painful, and electric stimuli in the region of the face supplied by the second division of the right trigeminal nerve; slight diminution in these forms of sensibility in the remainder of the right side of the face; subjective neuralgia in the same region, accompanied by a subjective

41. Head, H., and Holmes, G.: Sensory Disturbances from Cerebral Lesions, *Brain* **34**:102, 1911.

42. Courtney, J. W.: A Case of Thrombosis of the Left Posterior Inferior Cerebellar Artery, *Boston M. & S. J.* **166**:329, 1912.

43. Salmon, D. A.: Di un Caso di Trombosi dell' arteria Vertebrale a della Cerebellare Posteriore ed Inferiore, *Sperimentale* **66**:442, 1912.

feeling of extreme cold or, as the patient described it, "petrification"; distinct anhidrosis on the right side of the face and hyperhidrosis on the left side. Tactile sensibility was absolutely normal on both sides of the face.

CASE 25.—The next year, 1913, Robinson⁴⁴ reported a typical case. He used the usual pin prick test for pain sensibility, and for tactile sensibility he used in addition to cotton wool, Von Frey's hairs. On the left side of the face, he found an absence of sweating, and a subjective feeling of numbness. Tactile sensibility was normal over the whole body except on the left cornea, from which tactile stimuli elicited no response. Painful sensibility was decreased over the whole of the left side of the face; and heat and cold sensations, though produced by equally weak stimuli on both sides, were much duller from the left than from the right side of the face. The control of the muscles innervated by the fifth nerve was intact.

CASE 26.—Cadwalader,⁴⁵ 1913, reported a case which he believed due to partial occlusion of the posterior inferior cerebellar artery by a thrombus. The patient showed a distinct diminution of heat, cold, and painful sensibilities within the region of distribution of the second division of the trigeminal nerve. The area involved was about the size of a fifty cent piece, and lay just over the malar bone. It did not extend forward to the nose, nor backward to the ear, nor was either cornea, anesthetic. The nasal mucous membrane showed its normal sensibility, while that of the mouth and pharynx was almost insensitive. Tactile sensibility was unimpaired over both sides of the face.

CASES 27, 28, 29, 30, 31 AND 32.—In 1913, Goldstein and Baum⁴⁶ reported six cases of occlusion of the posterior inferior cerebellar artery, but gave, however, very meager data. In their first case, they reported disturbed sensibility on the right side of the face and tongue, but failed to mention either the type of sensibility which was involved, the nature of the disturbance, or the method they used to test for sensibility. Accompanying the sensory disturbance, there was a right sided conjunctivitis. The necropsy in this case revealed a degeneration of the spinal root of the right trigeminal nerve and of part of the substantia gelatinosa.

In the second case the threshold for painful stimuli on the right side was much higher than on the left, which was normal. They reported the right spinal fifth tract partially destroyed, but failed to locate the lesion more accurately.

The third case was more complete. The left conjunctival and corneal reflexes were absent, and painful sensibility on the left side of the nose, cheek and tongue was lacking. Tactile sensibility on the whole of the face was entirely normal. The necropsy disclosed a lesion in the spinal fifth tract, the exact location of which the authors did not specify.

Their fourth case showed a lessened sensibility to pain on the right side of the face, accompanied by loss of the corneal and conjunctival reflexes on the same side.

44. Robinson, G. W.: Occlusion of the Posterior Inferior Cerebellar Artery, *J. A. M. A.* **61**:179 (July 19) 1913.

45. Cadwalader, W. B.: Thrombosis of the Right Posterior Inferior Cerebellar Artery, *J. Nerv. & Ment. Dis.* **41**:375, 1913.

46. Goldstein, K., and Baum, H.: Klinische und anatomische Beiträge zur Lehre von Verstopfung der Arteria cerebelli posterior inferior, *Arch. f. Psychiat.* **52**:335, 1913.

In the fifth case, the sensibilities to temperature and pain of the left side of the face were entirely destroyed; corneal and conjunctival reflexes were partially lost on this side, and a subjective pain was felt in the same area.

The sixth case showed disturbance of pain and temperature sensibilities on the left side of the face and, on this same side, subjective painful and cold sensations.

In spite of their incompleteness, these cases point to a relationship between disturbance in pain and temperature sensibilities and destruction of the spinal fifth tract.

CASES 33 AND 34.—Two cases, in which the symptoms were very typical, but in which no necropsies were performed, were reported in 1914, by Gillis.⁴⁷ In the first case, there was absolute loss of pain and temperature sensibilities of the part of the face innervated by the first and second branches of the right trigeminal nerve, and a subjective numbness of the same region. There was ptosis of the lid, complete anesthesia of the cornea and conjunctiva, and enophthalmus of the eyeball on the right side; and the patient complained of a "peculiar feeling" in the right eye, and that his right nostril felt swollen. Tactile sensibility and tactile discrimination, as tested with cotton wool and a compass respectively, were found to be normal over the entire body.

The second case showed a complete analgesia and a hypothermesthesia of the upper part of the right side of the face, and an entire absence of corneal and conjunctival reflexes. Heat, warmth, and cold, when perceived at all, were accompanied by unpleasant affective elements. Tactile sensibility, as in the last case, was entirely normal.

CASE 35.—In the next year, 1915, an unusually good report of a case of occlusion of the posterior inferior cerebellar artery was published by Winkler.⁴⁸ He found painful sensibility destroyed and thermal sensibility much diminished (melting ice felt only cool, and hot objects, warm) throughout the whole of the left trigeminal area. The boundary line of this area was carefully determined. Anteriorly it corresponded with the median line, then passed over the top of the head, and returned in front of the ear and along the chin to again reach the median line. The left half of the oral cavity was analgesic, the tongue and palate being involved up to the midline; the left cornea was entirely anesthetic and no reflexes could be elicited from it nor from the conjunctiva. The palate and left side of the face were swollen; the latter was also markedly hyperemic and hot to the touch, but exhibited no trophic abnormalities. Winkler employed a plug of cotton wool, a small pencil and a pair of compasses to test tactile sensibility and localization, and found them diminished on both sides; but the motor control of all muscles innervated by the trigeminal nerve was entirely normal.

CASE 36.—In the same year, 1915, Spiller⁴⁹ described a case of occlusion of this same artery. The left side of the face was entirely insensitive to pain (pin prick), except over a small area below the mouth. Temperature sensibility was quite normal, though subjective "burning" in the region of distribution of the supraorbital nerve was noted. Tactile sensibility was intact

47. Gillis, A. C.: Occlusion of the Posterior Inferior Cerebellar Artery, *J. A. M. A.* **63**:1550 (Oct. 31) 1914.

48. Winkler, C.: A Case of Occlusion of the Arteria Cerebelli Posterior Inferior, *Proc. k. Acad. v. Wetensch. Amsterdam*, versl. **17**: Pt. 2, 914, 1915.

49. Spiller, W. G.: Remarks on the Central Representation of Sensation, *J. Nerv. & Ment. Dis.* **42**:399, 1915.

over the whole face. Spiller concluded from this case that there is a differentiation of pain from temperature fibers in the spinal tract of the fifth nerve.

CASE 37.—In 1919, a case was reported by Hausman.⁵⁰ He found analgesia of the entire left side of the face, and complete athermesthesia of the left temple, left cheek, and left side of the forehead, whereas tactile sensibility, tested with cotton wool, was normal over the whole of the face.

CASE 38.—Owen and Leighton,⁵¹ 1919, published the discussion of a slightly atypical case. They found that the right side of the face was insensitive to temperature stimuli; the face on the right, the inner cheek on the left, and the forehead, tongue, palate, and pharynx on both sides, were insensitive to pain. Tactile sensibility, tactile discrimination, and tickle sense were normal on both sides.

The bilateral disturbance on the forehead, and in the mouth and pharynx is obviously an aberrant condition, and may well be due to involvement of the secondary fibers of the fifth as they cross in the reticular formation from left to right (see Case 18).

CASE 39.—The last case published is that of Hall,⁵² 1920. The report was most incomplete, but the symptoms mentioned were quite typical. He wrote of a hemianesthesia on the right side of the face, but obviously included only pain and temperature sensibilities in this term, for he also stated that tactile and proprioceptive sensations were normal everywhere.

CASES WITH OTHER LESIONS

Besides cases of occlusion of the posterior inferior cerebellar artery, there have been other cases recorded in the literature, syringomyelia or hemorrhage directly into the brain substance, which have given symptoms of particular interest in the study of the central connections of the fifth nerve.

CASE 1.—The first case was reported by Wallenberg⁵³ in 1904. The patient showed marked disturbance in painful sensibility and a lesser disturbance in that of temperature on the right side of the face, which included the bridge of the nose, the lips, and the mucous membrane of the mouth and tongue. Touch was normal over the whole of the face.

At the necropsy he found a lesion in the medulla which involved the right spinal fifth nucleus, a few cells in the main sensory nucleus, and the dorsal part of the spinal root. In this case, though a few cells in the main sensory nucleus were destroyed, tactile sensibility was intact. Probably the injury was so slight that the overlap in distribution of fibers masked any deficiency. The lesion in the spinal root and nucleus account for the disturbance in pain and temperature sensibilities.

50. Hausman, L.: A Case of Occlusion of the Posterior Inferior Cerebellar Artery with Cardiac Manifestations and Involvement of the Left Vagus Nucleus, *Arch. Neurol. & Psychiat.* **1**:145 (Feb.) 1919.

51. Owen, S. A., and Leighton, P. A.: A Case of Medullary Symptom-Complex Dependent on a Lesion of the Left Posterior Inferior Cerebellar Artery, *Lancet* **1**:1024 (June 14) 1919.

52. Hall, G. W.: Occlusion of the Right Posterior Inferior Cerebellar Artery, *Arch. Neurol. & Psychiat.* **3**:584, 1920.

CASE 2.—In 1906, Head and Thompson⁵³ reported a case of progressive syringomyelia. Examination showed analgesia and hypothermesthesia of the entire face. Heat was recognized a little more easily than cold, especially on the left side. The patient complained of a subjective "peculiar" sensation on the left side of the face, which felt as if it had been rubbed with menthol. Tactile sensibility (cotton wool), discrimination, and localization over the whole body were perfectly normal, as was the motor control of the muscles innervated by the fifth. (Only a motor disturbance of the fingers and hand is mentioned.)

The main sensory nucleus and the motor nucleus of the fifth nerve are so very close together that it seems probable that a lesion in one, marked enough to show a disturbance, would also involve the other. As the motor nucleus was not injured, it may be concluded, even in the absence of necropsy, that the main sensory nucleus was also spared.

CASES 3, 4 AND 5.—Three cases of syringomyelia were reported by Kutner and Kramer⁵⁴ in 1907. The first case (Case 7 in their paper) showed a disturbance in the painful sensibility of the right side of the cheek and nose. Neither temperature nor touch sensibilities were disturbed, and the motor functions of the fifth were also entirely normal.

The lesion found at the necropsy included most of the spinal fifth nucleus, which showed considerable shrinkage, though it was not entirely gone. The upper part of the spinal and all of the main sensory nucleus were spared.

The second case (their Case 13) showed a disturbance of temperature and pain sensibilities in a semicircular area on the right side of the face, which extended from the forehead, halfway between the scalp and the eyebrows, to the middle of the chin. As the disease progressed, the boundary of the disturbed area advanced peripherally as a widening semicircle. At no time was there any disturbance of the motor fifth nerve.

The last case (their Case 14) showed a total loss of sensibility to both pain and temperature on the left side. The authors do not mention either tactile sensibility or motor fifth activity.

CASE 6.—Spiller,⁵⁴ in 1911, reported a case of syringomyelia which showed a complete loss of sensibility to pain, heat, and cold over the left side of the forehead, chin, and neck, and a partial loss over the left eyebrow and the cheek below the eye. The left side of the forehead also showed a slight diminution in tactile sensibility. There was, unfortunately, no necropsy in this case.

CASE 7.—Brun,⁵⁵ 1912, published a very complete report of a case. Tactile sensibility, as tested with delicate hairs and cotton wool, was intact over the whole face, and motor activity of the trigeminal was also entirely normal. Temperature and pain sensibilities, however, were greatly disturbed. On the right side: sensations of pain (needle prick) were absent from the whole face; warm

53. Head, H., and Thompson, T.: The Grouping of Afferent Impulses Within the Spinal Cord, *Brain* **29**:536, 1906.

54. Spiller, W. G.: Disturbances of Sensation in the Face in a Case of Syringomyelia, Indicating That the Upper Branch of the Trifacial Nerve Descends Lowest in the Medulla Oblongata, *J. Nerv. & Ment. Dis.* **38**:553, 1911.

55. Brun, R.: Ein Fall von doppelseitigen symmetrischen Erweichungssystem in verlangerten Mark nebst einem Herde im Kleinhirn, *Arb. a. d. Hirnanat. Inst. in Zürich von Monakow* **6**:273, 1912.

stimuli and cold stimuli could not be felt as such, although cold gave a "burning" pain on the upper third of the face, and on the lower two-thirds warmth was felt as cold; and reflexes from stimulation of the cornea, face, and mucous membrane were diminished. On the left side: there were athermesthesia and analgesia of the entire face except of the forehead and temple, and complete loss of the above mentioned reflexes.

The necropsy revealed, in the medulla, a syringomyelic cavity which occupied the area of the inner half of the substantia gelatinosa. The larger cells seemed to be involved in the degeneration, but the marginal cells were preserved. The degenerated region extended rostrad into the pons, and just reached the lower boundary of the main sensory nucleus; caudad, on the left side, it extended down to the cervical region, and the left spinal fifth tract was entirely degenerated; on the right side the dorsal part of the tract was spared, the central two-thirds alone showing a high grade degeneration.

CASE 8.—In 1915, an unusual case of multiple sclerosis was reported by Spiller.⁴⁸ The area of softening, indicated by complete paralysis of the muscles innervated by the motor fifth, was in the upper part of the pons, and involved the motor nucleus of this nerve. Tactile sensibility of the entire face was abolished, while pain sensibility was undisturbed and only a very slight disturbance in temperature sensibility was observed on the right side of the forehead. As the lesion included the motor nucleus, it is probable that the main sensory nucleus was also involved and, possibly, also the upper part of the spinal nucleus.

This case is especially interesting because it is the reverse of all the others. As, in them, tactile sensibility and motor function were spared together, so, in this case, they are alike involved, whereas pain and temperature sensibilities, usually destroyed, are here preserved. Correspondingly, the symptoms in this case were due to destruction of the motor and main sensory nuclei, with preservation of the spinal tract and nucleus, while the other cases all showed, primarily, lesions of the spinal structures alone.

SUMMARY AND DISCUSSION OF CLINICAL CASES

The evidence yielded by these cases, and the conclusions which seem justified by it, may be briefly summarized. Many cases, at necropsy, were found to have lesions of the spinal tract and nucleus of the fifth nerve on one or both sides. Such cases showed diminution or loss of pain and temperature sensibilities in areas on corresponding sides of the head, but never, unless the lesion actually included the main sensory nucleus, disturbance of tactile sensibility (Brun⁵⁵).

Other cases, which did not come to necropsy, showed the same dissociation of the tactile from the pain and temperature sensibilities of the head, with disturbances in the latter two; they also showed the other symptoms typical of occlusion of the posterior inferior cerebellar artery. As the region supplied by this artery extends rostrad, only to the lower border of the pons, the main sensory nucleus of the fifth nerve must have been spared in all these cases, the spinal nucleus and tract alone being involved.

In all these cases with sensory disturbances of pain and temperature but not of touch, additional evidence that the main sensory nucleus remained intact was found in the continuation of the normal function

of the motor fifth. The main sensory and the motor nuclei are so close together that they can be entirely distinguished only by differences in their cells, and, as shown by at least one case (Spiller⁴⁹), injury of the one would assuredly have been accompanied by injury of the other. As the motor nucleus must have remained intact in these cases, we may conclude that the main sensory nucleus was likewise uninjured.

One case is recorded which showed loss of tactile sensibility but not of pain and temperature sensibilities. Since in this case the masticatory muscles were paralysed, and no disturbance of medullary centers was indicated, it may be concluded that the main sensory nucleus, but not the spinal structures of the fifth nerve, was destroyed.

Thermal sensibility is disturbed in various ways. In many cases it is entirely abolished; in others only sensibility to heat is impaired, cold being felt in a normal manner; and in still others the application of heat elicited a sensation of cold, or cold a sensation of heat. The loss of heat sensibility but not of cold, in some cases, suggests a segregation of these fibers within the spinal fifth tract in the medulla.

Besides the objective symptoms, many patients reported subjective pain and temperature sensations in the anesthetic region. This may be attributed to a zone of hyperirritability surrounding the area of destruction. The frequent disturbance of sweat secretion in the areas of athermesthesia is of interest.

The most important conclusion which may be drawn from the above data is that the afferent impulses of pain and thermal sensibilities from the fifth nerve descend through the medulla in the spinal tract of that nerve, and pass at various levels to the cells of the spinal nucleus; whereas, the tactile impulses from the face pass to the cells of the main sensory nucleus. Such a distribution has been previously suggested by Winkler,⁴⁸ and Spiller.⁴⁹

III. EXPERIMENTAL WORK

The experiments to be described were carried out to test the validity, under more accurately controlled conditions, of the conclusion arrived at by a survey of the clinical evidence—that tactile impulses reached the main sensory nucleus of the fifth nerve, whereas thermal and painful impulses reached the spinal nucleus. We were able to cut the spinal root of the fifth nerve in the medulla at a level just below the bifurcation of the sensory fibers. This cut severed the whole of the spinal fifth tract from its peripheral portion, but left intact the fibers destined for the main sensory nucleus. The appearance or non-appearance of reflex activity in response to various stimuli, was the test used to determine which types of sensibility were impaired by the interruption of the spinal tract, and which types were left intact.

This method necessitated an exact knowledge of the sensory innervation of the face, especially of any overlapping of the two trigeminal areas at the median region, as a double sensory path would insure the presence of reflex activity even if one path were interrupted as described. To this end the whole fifth nerve on one side was completely severed proximal to the ganglion and the reflex activity from stimuli on both sides of the face was carefully tested.

A second objective of this research was the determination of the lowest level at which interruption of the spinal fifth root would still cause a dissociation of pain and tactile sensibility. For this purpose, we severed the root at various levels between the region of the origin of the tract and the region of the bifurcation of the pyramids, and again tested the integrity of the sensory paths by the presence or absence of a reflex involving them. Since cats are easier to work with than dogs, and also yield more delicate vasomotor reflexes, these animals were used throughout the course of the experiments.

SURGICAL TECHNIC

In the majority of the cases, urethane was used as the anesthetic, because reflex activity is not depressed, but rather facilitated, by this drug, and it was, therefore, particularly favorable for this work. An intraperitoneal injection of 0.75 gram of urethane (in solution) per kilogram of body weight was found to be satisfactory. In a few cases, when surgical anesthesia could not be produced by urethane alone, ether was used with it, and was given either by mask or by tracheal cannula. When reflexes were not to be tested till several days after the operation, the cats were anesthetised with ether alone, given by mask.

Entrance into the cranium and exposure of the spinal root of the fifth nerve was effected in two ways: (1) through the roof of the mouth, and (2) through the occipital bone. For the first approach, the cat was tied, dorsal side down, with the head just over the end of a board, the mouth was clamped open by a device arranged to keep it at its maximum opening, and the tongue was pulled out and tied. A cut was then made through the middle of the soft palate, and the two flaps, so formed, were held apart by threads which passed through each and were tied together over the bridge of the nose. This exposed the posterior wall of the nasopharynx. The mucous membrane was scraped with a chisel from the tympanic bulla and from the whole area of the basilar part of the occipital bone, laterad to the midline; then, with a dentist's drill, about three millimeters in diameter, the scraped medial wall of the tympanic bulla was removed. After removal of the bulla, which overhangs the occipital bone, it was possible to bore a hole in the latter just mediad to the bulla at its posterior third. The hole was made four to five millimeters in diameter and was

extended into the cranial cavity, where it usually opened into the inferior petrosal sinus. The resulting hemorrhage was allowed to drain into the mouth so that no intracranial clots, which would press upon the medulla, would be formed; the bleeding usually stopped in two or three minutes, when a small part of the medulla could be seen through the hole. This was the ventrolateral portion of the medulla at the level of the dorsal cochlear nucleus.

The spinal trigeminal fibers were cut with a curved cataract knife which had been ground so that only the distal centimeter possessed a cutting edge. This knife, held vertically with its cutting edge turned laterad, was passed through the hole in the bone and through the underlying medulla until its point reached the covering bone. The knife thus passed entirely through the medulla, from ventral to dorsal surfaces, just mediad to the fifth tract, and had its cutting edge directed towards that tract. The blade was then forced laterad by moving the handle in a medial direction, the hole in the bone serving as fulcrum; it was forced ventrad by raising the whole knife. The cut so made included the whole of the spinal fifth tract, a small area of the nucleus of the tract, and, occasionally, a small part of the restiform body and the overlying dorsal cochlear nucleus. The exact lesion produced was always checked by necropsy.

Occasionally the cat showed signs of shock after cutting the medulla. When apnea supervened, artificial respiration in the form of an interrupted air current was used.⁵⁶ The sensory tests were never made until the cat showed complete recovery from shock, so that the reflexes were as lively as in the normal animal.

When desired, blood pressure was taken from the carotid artery with a mercury manometer, and respiration was recorded from a tracheal cannula with attached tambour.

This method of severing the spinal tract proved to be most satisfactory when animals were to be experimented upon immediately. There was but little hemorrhage and only slight trauma to the tissues, and, therefore, less shock from the operation. It did not permit one, however, to make the cut accurately at a desired level, because the area exposed was small and the position of the medulla in the cranium slightly inconstant. For those experiments, therefore, in which it was essential to know the exact level of the cut, and desirable to make

56. It is interesting to note that very often diaphragmatic breathing alone reappeared, the thoracic muscles never regaining activity. It is possible that the afferent path for the respiratory reflex to the intercostals was interrupted. Coombs and Pike (*The Rôle of Afferent Impulses in the Control of Respiratory Movements*, *Proc. Soc. Exper. Biol. & Med.* **15**:55, 1918) believe that the impulse must ascend as far as the corpora quadrigemina before a reflex can result.

several cuts at different levels, the entrance into the cranium was made through the occipital bone in the following manner.

The hair was clipped from the dorsal surface of the head and neck, and the skin was cut from the vertex capitis down to the level of the first or second cervical vertebra. On the side on which the medulla was to be exposed, a cross cut was made mid-way between the ends of the longitudinal cut and was extended laterad to the ear. The two resulting flaps of skin were reflected and held out of the field by towel forceps. To eliminate hemorrhage as much as possible, a small amount of a 1:1000 solution of epinephrin hydrochloride was injected into the muscles along the line in which they were to be divided.

The muscles attached on either side of one lateral half of the inferior nuchal ridge were cut as near to the bone as possible; and also, by a second cut at right angles to the first, which extended rostrad as far as the superior nuchal line and caudad to the inferior edge of the first cervical vertebra, the muscles along the external occipital crest were divided. The bits of muscle which remained were scraped away from the underlying bone with a small periosteal elevator.

On the one side, then, the surface of the occipital bone was entirely clean. In this area, a circle of bone, with the superior nuchal line as a diameter, was ground very thin, by the use of the dentist's drill already mentioned, and the remaining sheet was removed with bone forceps. The preliminary grinding considerably reduced the amount of hemorrhage from the bone, and bone wax pressed into the open edges stopped the little which was unavoidable. After the circle of bone had been entirely removed, the dura mater covering the posterior part of the cerebellum and the lower and lateral part of the medulla could be seen. This dura was opened over the cerebellum to preclude any possibility of injuring the medulla. The cerebrospinal fluid was allowed to drain and the cerebellum was then lifted up and held backward, with a small retractor, in such a way that the whole lateral wall of the medulla could be seen. The spinal fifth tract was thus exposed along the whole of its course through the medulla and, with the knife already described, could be cut at any desired level without injury to adjacent structures.

This operation, in contrast to the other, involved much trauma and hemorrhage, and left the animal in a shocked condition. The muscles were, therefore, sewed back into place, the skin was sutured over the wound, and the cat was allowed to recover from the operation. Usually 20 to 50 c.c. of sterile isotonic saline solution was injected intravenously. From five to twenty-four hours after the operation the cat, as a rule, showed sufficient recovery to permit the continuation of the experiments.

Another method was used to cut the whole fifth nerve before it enters the pons (trigeminal neurectomy). This was always performed under strict asepsis and the cats were allowed to live for several days. The hair was thoroughly removed from the head anterior to the ear, and a skin incision was made just in front of the ear perpendicular to the main axis of the body. The temporal muscle thus exposed, was then cut and scraped from the underlying bone. A hole, 1.5 centimeters in diameter, was trephined through the frontal bone over the lateral edge of the frontal lobe of the hemisphere. This lobe was lifted with a small retractor, from the floor of the cranium, and the Gasserian ganglion in its depression on the apex of the petrous portion of the temporal bone was exposed. A cut was then made through the whole nerve proximal to the ganglion with a curved knife similar to that already described. The muscles and skin were sutured in the usual way and the cat was allowed several days in which to recover from the operation. It was found necessary after the operation to clean the eyes daily with mild protargin.

METHODS OF EXPERIMENTATION

At first, we attempted to test pain sensibility in different parts of the face by stimulation with needle electrodes which pierced the skin. This method was found to be very unsatisfactory; the cat repeatedly reacted to painful stimuli even after the spinal tract had been completely severed. The possibility suggested itself that deep pain fibers were present in branches of the seventh nerve which supply the muscles of expression, and that these afforded an afferent path for pain reflexes. In confirmation of this, we found that electrical stimulation on both sides of the face elicited reflexes in the cats with the entire fifth nerve cut on one side. It is interesting to note in this connection that Maloney and Kennedy,⁵⁷ 1911, demonstrated in man that deep sensibility of the face is retained after gasserectomy.

Since it was impossible satisfactorily to eliminate sensations carried by the seventh nerve, from this field, we chose to stimulate the cornea only. This is a particularly favorable region in which to test painful sensibility, as it is innervated exclusively by pain fibers from the fifth nerve (Schäfer¹). The nictitating membrane has a second sensory supply (either through overlapping of the opposite fifth, or from the seventh nerve), for stimulation of it called forth a response even with the entire fifth nerve on the same side cut. We were always careful, therefore, that the electrodes did not touch this membrane when we stimulated the cornea.

57. Maloney, W. J., and Kennedy, R. F.: The Sense of Pressure in the Face, Eye and Tongue, *Brain* 34:1, 1911.

When painful sensibility of the cornea was intact, stimulation with a tetanizing current caused typical reflexes. The lids closed tightly over the eyeball; there was bodily struggling; the forepaws moved toward the eye; and the blood pressure usually rose markedly, and was accompanied by an irregularity in the rate of respiration.

The most delicate test for tactile sensibility mediated through the trigeminal nerve, is the sneeze reflex; very light stimuli in the interior of the nostril are sufficient to bring forth marked sneezing. A fine camels hair brush of nine to ten hairs, or a little cotton wool on the end of a probe, touched lightly to the distal part of the nostril until the sneezing commenced, was found effective. The cat under urethane, but not ether, was found to be just as sensitive to such stimuli as an unanesthetized cat. The sneeze was registered in the respiratory tracing.

As a third test for the integrity of sensation in the trigeminal area, we used the oculocardiac reflex. A very excellent discussion and review of the literature on this reflex was given by Naccarati⁵⁸ in 1921. The reflex, described first by Dagnini and by Aschner in 1908, consists of a slowing of the pulse, a modification of respiratory rhythm and, rarely, a lowering of blood pressure, as the consequence of pressure on the eyeball of the subject. It is exaggerated by severing the cervical cord (which interrupts the sympathetic connections with the medulla), and is abolished by cutting both vagi, so that the efferent path of this reflex must lie in the vagi. The afferent path is in the fifth nerve, for injury to that nerve prevents the reflex. The response, Naccarati believes, is probably not due to stimulation of pain fibers, for it is not produced by painful pressure upon the mandible or forehead.

Urethane augments reflex vagal activity (Becht⁵⁹), so that cats anesthetized by this drug are very favorable for this test. The reflex was elicited both by the usual pressure and by stimulation of the cornea with a tetanizing current, and the resultant slowing of the heart was recorded on the tracing from the carotid.

At the end of all experiments the cats were killed and necropsies were performed. The exact position of the cut was noted and the medulla was removed for histologic examination by the pyridin silver method of Ranson.⁶⁰ The tissue was imbedded in paraffin and cut in serial sections ten microns in thickness, in such a way that the fifth

58. Naccarati, S.: The Oculocardiac Reflex (Dagnini-Aschner Phenomenon), Its Use in Medicine and Psychology, *Arch. Neurol. & Psychiat.* **5**:40 (Jan.) 1921.

59. Becht, F. C.: Personal communication to the author, 1921.

60. Ranson, S. W.: The Pyridine Silver Method, with a Note on the Afferent Spinal Nonmedullated Nerve Fibers, *Rev. Neurol. & Psychiat.* **12**:467, 1914.

nerve could be followed into the medulla, the point of bifurcation of the fibers seen, and the whole spinal tract of the nerve below the level of the cut followed (Fig. 1). The whole of the lesion was always included in the material sectioned.

EXPERIMENTAL RESULTS

The sensitivity of the cornea to painful stimuli, that is, to a tetanizing current, was eliminated in each of the twenty-one cats in which the spinal root had been completely cut across. This analgesia appeared only on the side of the lesion, and did not involve the cornea

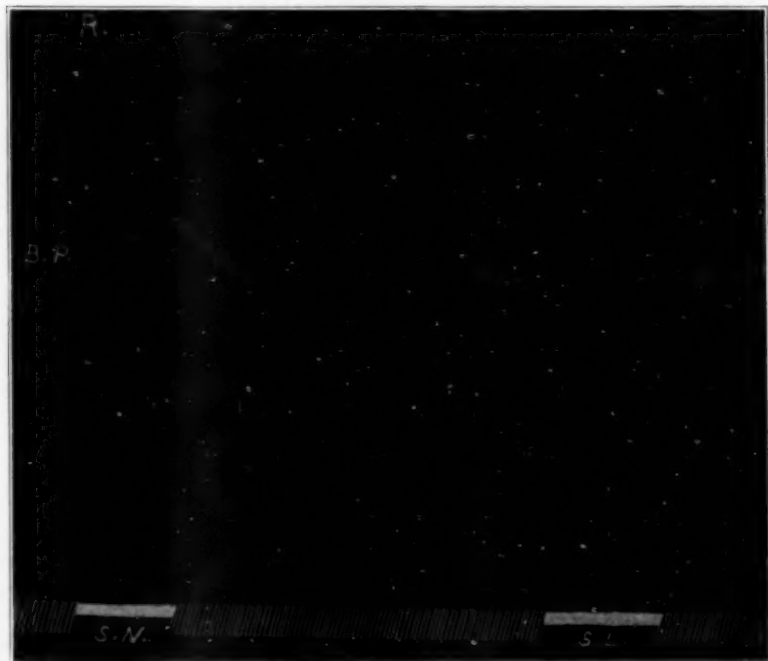


Fig. 2.—The vasomotor reflex from painful stimuli. *S N*, stimulation of the cornea on the normal side. *S L*, stimulation of the cornea on the side of the lesion. *R*, respiratory tracing. *B P*, blood pressure tracing.

of the normal side; stimulation of the latter always led to marked struggling, dilatation of both pupils, and a rise of 8 to 17 mm. in blood pressure. These are well recognized pain reflexes (Fig. 2).

The respiratory reflexes showed great variation. Stimulation of the analgesic cornea in no way modified respiration. Stimulation of the normal cornea caused: (1) no effect in four cats; (2) slight decrease in amplitude in three cats; (3) marked irregularity in seven cats; (4) apnea during stimulation in one cat; and (5) partial inhibition, followed by a period of marked irregularity, in one cat.

These respiratory variations were neither constant nor uniform enough to be considered as real indications of pain. The other reflex effects, struggling, dilatation of the pupils, and rise in blood pressure, were constant in their appearance, and may surely be interpreted as pain reactions. Since they were always present on the normal side and never on the side on which the spinal fifth tract had been cut, it seems reasonable to conclude that painful sensibility of the cornea was abolished by such a cut.

The sneeze reflex was used as a test for tactile sensibility on the last eleven cats. The touch of a little cotton wool in either nostril caused marked sneezing, preceded by licking movements of the tongue over the upper lip toward the nose. The reflex followed a latent period which varied from two or three seconds to seventy or seventy-five seconds and which was not constant even in one individual (Fig. 3). A rise in blood pressure usually accompanied the sneeze, but did not occur if the thorax was first opened; this indicated that the rise in blood pressure was secondary to the exaggerated inspiratory phase of respiration which precedes the sneeze. Cats with the spinal fifth tract of one side cut, and which were insensitive to painful stimuli of the cornea of that side, still gave a good sneeze reflex from tactile stimuli in either nostril. This was not due to an overlapping of fibers from the normal side, since four cats, with the whole sensory root of the trigeminal of one side cut, sneezed normally when stimulated with the camel hair brush on the normal side but did not sneeze or show any other indications of tactile sensibility when stimulated on the side on which the nerve had been cut. It may be noted that, in these cats, stimulation of either nostril with electrodes called forth marked pain reflexes. Either the pain fibers of the fifth nerve, in contrast to the tactile fibers, do overlap, or deep fibers from the seventh nerve were stimulated, or, possibly, the reaction was due merely to a spread of current, since the two nostrils are very close to each other.

Nor could the persistence of reflex effects from the nostril, after disappearance of those from the cornea, have resulted because the corneal fibers alone were included in the cut and on the assumption that the fibers which innervate the nostril terminate at a higher level of the spinal fifth tract than do those which innervate the cornea. In every case, except two, the tract was cut just below the bifurcation of the fibers, so that all the descending fibers must have been severed before any of them could have terminated. Only the fibers going to the main sensory nucleus were left, and the tactile sensations from the nose must, therefore, have passed along them.

Pressure on the eyeball of the normal side, in three cats under the influence of urethane only, caused distinct vagal slowing of the heart and also body struggling, while pressure on the eye of the side on

which the spinal fifth tract had been cut, in no case caused a response (Fig. 4). Electrical stimulation (tetanizing current) of the eyeball of the normal side, but not of the side which had been operated on, also led to slowing of the heart and to struggling movements. Since the tetanizing current, which certainly leads to painful sensations, produces the same effects as pressure, and since the responses to pressure stimuli

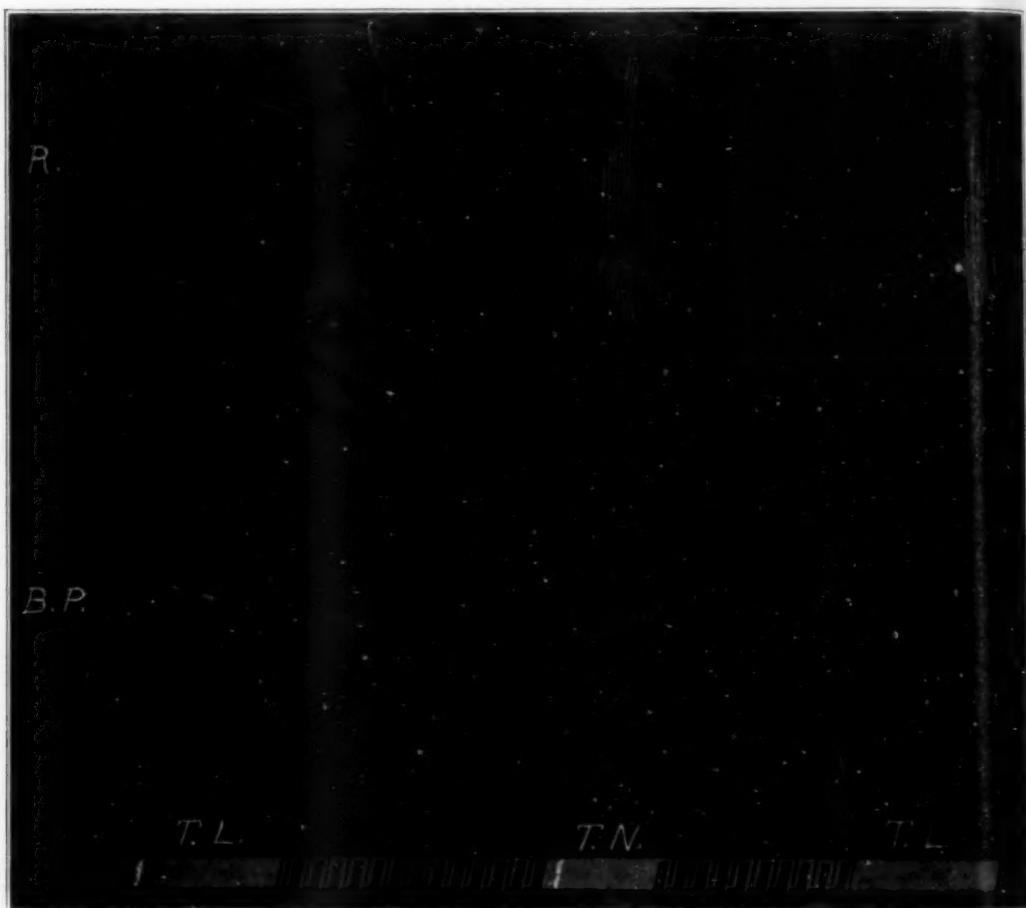


Fig. 3.—The sneezing reflex. *T L*, tickle of the nostril on the side of the lesion. *T N*, tickle of the nostril on the normal side. *R*, respiratory tracing. *B P*, blood pressure tracing.

are abolished by section of the spinal fifth tract, as are pain reactions, it seems that the oculocardiac reflex is due to stimulation of the pain fibers of the trigeminal nerve. Naccarati's observation that painful stimulation of the forehead and jaw does not slow the heart merely serves to emphasize the specific character of this reflex from the eye.

Histologic examination of the medullas showed that, in all cases in which the pain reflexes from the cornea had been entirely eliminated, the spinal fifth tract had been completely severed. In most, the spinal trigeminal nucleus and, occasionally, the reticular formation medial to the nucleus, were also slightly injured. The cut was usually found just below the bifurcation of the sensory fibers, but in two cases was about five millimeters below that point. The physiologic results in these two experiments were no different from the others. The cut was never found above the bifurcation of the sensory fibers, and the fibers going to the main sensory nucleus were intact in every case (Fig. 1).

In the preceding experiments, a high section of the spinal fifth tract was made, and histologic examination showed that the trigeminal fibers

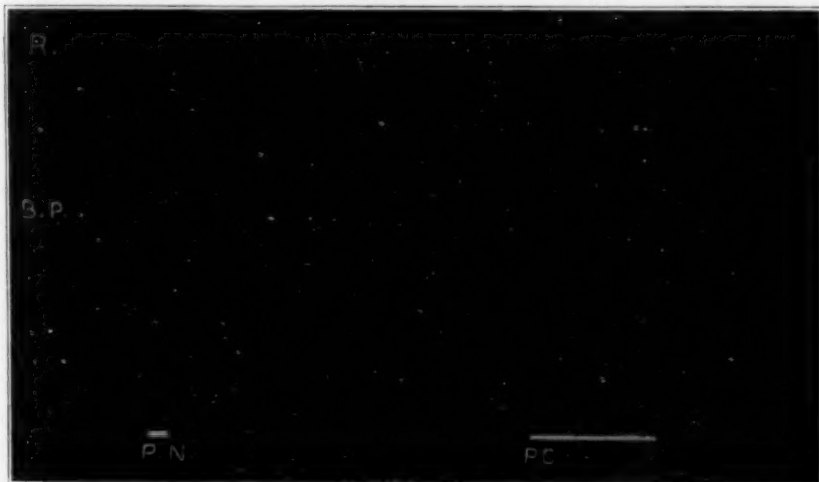


Fig. 4.—The oculocardiac reflex. *P N*, pressure on the eyeball of the normal side. *P C*, pressure on the eyeball of the side of the lesion. *R*, respiratory tracing. *B P*, blood pressure tracing.

had been cut just below their bifurcation, so that none of the descending fibers were left intact. To determine the level to which the pain fibers from the cornea descend before they terminate, a series of cuts in the tract were made, starting at the level of the obex, and gradually ascending the tract, until stimulation of the cornea no longer elicited reflexes. In four such cases, it was found that the cuts which eliminated the pain responses were 5.9, 6.7, 6.8 and 7.1 millimeters below the bifurcation of the fibers. In all except one case, the cut which proved effective was not more than 1.5 millimeters above the previous one (in the one exception, the effective cut was 2.1 millimeters above the previous one), so the margin of error was small.

These results indicate that the pain fibers from the cornea terminate just below the upper 5 to 7 mm. of the tract, and are in agreement with the clinical findings of Solder¹⁹ and Schlesinger,²⁰ to which reference has already been made—that the fibers supplying the eye and nose terminate in the upper part of the tract.

COMMENT

The experimental results are thus in entire accord with the clinical evidence, and demonstrate that painful sensations from the trigeminal area pass only by way of the spinal fifth tract and nucleus, while tactile sensations from the same region travel by way of the main sensory nucleus. Besides its diagnostic value, this fact possesses significance in two connections.

The spinal fifth tract is the direct upward continuation of the tract of Lissauer, and the spinal fifth nucleus is continuous with the substantia gelatinosa. Ranson⁶¹ has demonstrated that pain fibers from the spinal nerves pass into the tract of Lissauer and terminate in the substantia gelatinosa; so that the essential similarity of the painful innervation of spinal and cranial regions becomes apparent. The spinal fifth and Lissauer's tracts, and the spinal fifth nucleus and substantia gelatinosa are thus not only anatomically continuous but also physiologically identical.

Most, if not all, of the sensory fibers of the trigeminal nerve bifurcate and the smaller branch of each passes exclusively to the main sensory nucleus, while the larger reaches only the spinal nucleus. The dissociation of pain and temperature might possibly be explained as follows. It has not been conclusively demonstrated that all fibers bifurcate. Possibly the small myelinated and unmyelinated fibers carry pain and enter the spinal tract without bifurcation; the larger fibers carry touch (and possibly temperature—this case is not so clear) and send branches to both nuclei. Tactile sensation, having a double path, would thus persist after separation of the spinal tract from the nerve, while painful sensation could not.

This explanation is improbable for two reasons. First the vast majority of the trigeminal fibers certainly bifurcate; it is not probable that only the small fraction which may not do so is concerned in the transmission of pain sensations, while the two, hardly more important, sensations of touch and temperature are so generously supplied with transits. Secondly, if tactile impulses may follow either one of two paths, injury to the main sensory nucleus should not block them any more than does injury of the spinal nucleus, and if both of the nuclei

61. Ranson, S. W.: An Experimental Study of Lissauer's Tract and the Dorsal Roots, *J. Comp. Neurol.* **24**:531, 1914.

were involved, pain, as well as touch sensibility, should be lost. Yet in one case of syringomyelia (Spiller,⁶²) which involved the main sensory but not the spinal nucleus, pain was normal and touch was abolished. It appears, therefore, that pain impulses pass exclusively through descending fibers and touch impulses exclusively through ascending fibers. Since the ascending and descending fibers are, in most cases at least, branches of a single afferent fiber, it follows that both pain and touch impulses probably pass for a distance along the same nerve fiber.⁶²

As Lucas⁶³ points out, the character of a nerve impulse depends only on the condition of the nerve through which it is passing and not at all on its past history. If one impulse which reaches the point of bifurcation of a fiber follows only one branch, so must all others; and, as in the case of the trigeminal fibers, if some impulses reach each nucleus, it follows that all impulses must reach both. Yet impulses originating in pain end-organs can produce conscious and reflex effects only when they reach the spinal nucleus, and impulses originating in tactile end-organs are effective only when they reach the main sensory nucleus, though all impulses reach both. The following explanation seems plausible.

Forbes and Gregg⁶⁴ have secured evidence that a single stimulus of an end-organ may cause a series of nerve impulses in rapid succession to pass along the nerve fiber. The frequency of impulses may be different for each type of end-organ, and two different synapses may be "attuned"⁶⁵ to different frequencies; so that the impulse frequency from a painful stimulus may be able to pass the synapse to the spinal nucleus but not the one to the main sensory nucleus, while the impulse frequency from a tactile stimulus may be able to pass only the latter. Such a relationship would account for the observed facts, and is being further investigated.

62. Herrick, C. J.: *An Introduction to Neurology*, Philadelphia, W. B. Saunders Company, 1918.

63. Lucas, Keith: *The Conduction of the Nervous Impulse*, New York, Longmans, Green & Co., 1917.

64. Forbes, A., and Gregg, A.: *Electrical Studies in Mammalian Reflexes*, *Am. J. Physiol.* **39**:172, 1915.

65. Lucas (1917) suggests an "attunement" of this type. Immediately (0.002 sec.) after the passage of one impulse, a nerve fiber is entirely refractory to a second; later (0.013 sec.), a second impulse will be transmitted as one of low intensity; still later (0.03 sec.), as one of higher intensity than normal; and finally in the same manner as the first impulse was transmitted. The synapse is a region of conduction with a decrement, so that a series of impulses rapid enough to fall each in the relative refractory period of the last would be extinguished. One synapse might thus permit one frequency of sensory impulse to pass and bar a second, while another synapse, because of a different decrement, might act differently.

CONCLUSIONS

Besides offering data on the anatomy of the central trigeminal structures in cat and man, the following physiologic observations have been discussed:

1. Painful, and possibly thermal, stimuli in the trigeminal area produce conscious and reflex effects via the spinal fifth tract and nucleus only, while tactile stimuli produce effects via the main sensory fifth nucleus only (39 cases of occlusion of the posterior inferior cerebellar artery, 8 other human cases, and 21 cats with experimental lesions).

2. Pain fibers from the cornea terminate just below the upper seven millimeters of the spinal tract (cat). Pain fibers from adjacent regions descend further (human).

3. The fields of tactile sensibility of the two trigeminal nerves supplying the nose do not overlap (cat).

4. The adequate stimulus for the oculocardiac reflex is pain rather than pressure, and the reflex path includes the spinal fifth tract.

5. The spinal fifth tract and nucleus are functionally related to the tract of Lissauer and the substantia gelatinosa respectively.

6. Deep pain sensation from the facial muscles is probably carried by the facial nerve.

7. These results favor the view that impulses from more than one type of sensory stimulus may be transmitted by the same nerve fiber.

HEREDITARY AND NONHEREDITARY MENTAL DEFECT

A COMPARATIVE STUDY *

HOWARD W. POTTER, M.D.

Clinical Director, Letchworth Village

AND

RUBY SMITH VIERS, M.D.

Assistant Physician, Letchworth Village

THIELLS, N.Y.

The relation of hereditary influences to mental defect has been unquestionably established by the researches of students of both eugenics and feeble-mindedness. Little or nothing has been brought out, however, as to the *fundamental* inherited factors from which issue defective mentality. Furthermore, according to figures given by the various workers, the percentage of mental defectives having an impaired heredity ranges anywhere from 50 to 85. The authors are inclined to believe that an explanation for this variation of defective antecedents might be found in the geographical location or source of their material, as it is an experience common to all workers in mental deficiency that certain localities contribute an unusually large number of defectives with typical family histories, many members of whom are inter-related. It is our impression that approximately 50 per cent. of the patients at Letchworth Village are free from defective antecedents.

For years we have read, spoken and heard nothing but heredity, eugenics and segregation in relation to the defective. Strange to say, little attention has been given to the mental defective with a negative family history. It appeared to us that possibly a fruitful field might be presented if an effort were made to understand what differences, if any, could be found by an investigation of patients with hereditary and nonhereditary mental defect.

It is our aim to uncover certain leads, which will require much more intensive work before deductions of any value can be made. Conclusions based on the present study would be wholly unjustifiable for obvious reasons.

In selecting material for this study, cases were chosen in the order of the admission of the patients to an institution for mental defectives. Those cases whose histories were lacking, incomplete, or questionable as regards their validity, were immediately discarded. The cases selected were reviewed by three persons, all of whom were familiar with the histories.

* Read at the Interhospital Meeting at Hudson River State Hospital, March 16, 1922.

In this manner 100 cases were selected, half of which belonged to the group with hereditary mental defect and the other half to the group with nonhereditary mental defect. The hereditary group comprised patients one or more of whose ancestors had a definite history of mental defect. In order to qualify for the nonhereditary group, the family history of the patient had to be complete for three generations and free from all indications of defective, psychotic or other grossly maladaptive traits.

Each case was reviewed with special attention to etiology other than heredity, intelligence, physical characteristics, defects and diseases. Relative to etiologic factors other than impaired heredity, those assumed from the history given were classified as antenatal influences, accidents and injuries, disease of the central nervous system, and acute infectious diseases. The intelligence quotient or percentage of normal intelligence, rather than the actual mental age, was used to represent the intellectual development. This was necessary because the cases studied were of varying chronologic ages—some children and some adults. Physical defects and diseases were noted in terms of general medicine, neurology and endocrinology. The height and weight were used as an index of general physical growth and development.

HEREDITARY MENTAL DEFECT

Sex and Age.—In this group were twenty-nine males and twenty-one females. The ages varied from 5 to 30 years. Of these, thirty-nine were below the age of 16, and eleven above that age.

Etiology.—In forty-two cases there were no facts of an etiologic significance in the antenatal or developmental period of life.

Two patients gave a history of prolonged and difficult labor; however, there was nothing in their physical condition to point to this as having been a legitimate factor in causing their defective mentality.

At the age of 2 years, one patient had meningitis and another, poliomyelitis. Neither of these have any residuals of neurologic significance.

A cretin had poliomyelitis at the age of 4 and has now a characteristic extensor paralysis with a consequent pes equinus deformity of the right foot. Obviously the poliomyelitis does not account for her intellectual defect. One patient developed a hemiplegia at 13 months of age, and at the present time this is substantiated by the neurologic condition.

Relative to infectious disease, one patient had measles and pneumonia when 13 weeks old and another had whooping cough accompanied by convulsions during the first year of life. Neither of these patients have any physical evidence to show that a cerebral injury was produced at that time.

Intelligence.—The intelligence quotient ranged from 25 to 82, the average being 56. From the standpoint of classification, there were no idiots in this group; five were imbeciles, thirty-five were morons and ten were borderline types.

Physical Characteristics, Defects and Disease.—Height and Weight: The average height and weight of the males in this group was 56 inches (142.24 cm.) and 83 pounds (37.64 kg.), respectively. This represents an underheight of $2\frac{1}{2}$ inches (6.35 cm.) and an underweight of $10\frac{1}{2}$ pounds (4.76 kg.) in comparison with the normal average of the same ages.

Relative to the females, the average height and weight was $56\frac{1}{2}$ inches (143.5 cm.) and 91 pounds (41.27 kg.), respectively. This represents a deficiency of $2\frac{1}{2}$ inches (6.35 cm.) and $9\frac{1}{2}$ pounds in height and weight, respectively, when compared with the average normal females of the same ages.

Defects and Diseases: In twenty-four cases no signs which could be regarded as pathologic were found. Three patients showed a pigeon breasted deformity of the sternum with flared costal margins, indicating in all probability a rachitic condition during the developmental period. Two patients had the Hutchinson type of incisors, but in both of these the blood Wassermann test was negative. Five patients had pulmonary signs pointing to a probable tuberculosis. One patient had valvular heart disease. Fifteen patients had signs of an endocrinopathy. Eleven of these were of the status-thymico-lymphaticus type, two pituitary and two thyroid. Three had neurologic defects or disorders. In one of these the deep reflexes were absent, although this seemed to have no pathologic significance. Another had the characteristic residuals of an old hemiplegia. The third presented a unilateral retardation of development with muscular weakness, absent deep reflexes and double lateral nystagmus.

The blood pressure ranged from eighty (80) to 180 systolic, with an average of 108. The diastolic pressure varied between the lower and upper limits of 20 and 88, respectively, with an average of 69. Incidentally the average age of this group was $13\frac{1}{2}$ years.

Only two patients in this group had a positive Wassermann reaction in the blood. There was nothing in the general physical condition of either of these patients to cause one to be suspicious of a syphilitic infection.

NONHEREDITARY MENTAL DEFECT

Sex and Age.—Of this group, thirty were males and twenty were females. The ages ranged from 6 to 41 years. Twenty-seven of the patients were below the age of 16 and twenty-three above. The average age was 17 years.

Etiology.—Nineteen cases showed nothing of etiologic significance in their histories.

Three patients were born two months prematurely. There was nothing in their present physical condition to warrant the assumption that the prematurity was significant in the production of their mental defect.

Four patients had parents who were alcoholic, tuberculous or physically much below par. One of these patients, a mongolian idiot, was born of an eclamptic mother.

One patient gave a history of hereditary syphilis. This was not evident in his physical findings, however.

Ten patients gave a history of abnormal birth. Nine of these were instrumental deliveries after a prolonged labor and one a precipitate delivery; the latter was entirely negative from the standpoint of the physical examination. Of the other nine, five had neurologic defects: one had paralysis of the arm, one spastic paraplegia, two hemiplegia, and one progressive muscular atrophy.

Three patients had anterior poliomyelitis during the first two years of life; two of these now present the characteristic sequellae. Three had meningitis in early childhood. One of these is entirely deaf, one has hemiplegia, while the third shows no physical defects. One patient had a central lesion with convulsions during the first month of life and at present has choreiform movement of the hands and feet. One patient had sporadic convulsions during his entire infancy. This was a case of mongolian idiocy. One patient had had a spastic diplegia since birth. One patient had whooping cough during the first year of life, but the physical condition when examined was negative. One patient gave a history of a head injury followed by unconsciousness and convulsions, although physical examination failed to disclose anything of significance in this respect.

Two patients were undoubtedly not to be regarded as mentally deficient until the ages of 9 and 10, respectively. The former was a definite case of dyspituitarism, while the latter became defective following lethargic encephalitis.

Intelligence.—The intelligence quotient ranged from 10 to 91, the average being 41. Twelve patients were classified as idiots, twelve were imbeciles, twenty-four were morons and two were of the borderline type.

Physical Characteristic, Defect and Disease.—Height and Weight: The average height and weight of the males of this group was 57½ inches (146.05 cm.) and 92 pounds (41.73 kg.), respectively. This represented 1 inch (2.54 cm.) underheight and 11½ pounds (6.79 kg.) underweight. Relative to the females, the average height was 63

inches (160.02 cm.) and weight 122 pounds (55.33 kg.). This means an overheight of 4 inches (10.16 cm.) and an overweight of 22 pounds (9.97 kg.), as compared to the normal average for the same ages.

In twenty cases there were no physical defects or diseases.

Five patients showed a characteristic rachitic deformity of the thorax. Three patients had signs indicative of pulmonary tuberculosis. One patient presented a cardiac arrhythmia. One patient had a valvular heart lesion. One patient was extremely emaciated. Fourteen showed a defective internal glandular balance. Four of these were of the status-thymico-lymphaticus type, three of the pituitary, four of the thyroid, one of the gonadal, and two of the pluriglandular or mongolian type.

Eleven patients showed neurologic defects or diseases. One patient had an eighth nerve deafness, one monoplegia, three hemiplegia, two spastic diplegia. Two patients had the characteristic sequellae of anterior poliomyelitis; one had progressive muscular atrophy; one had marked choreiform and athetoid movements of the upper and lower extremities.

The systolic blood pressure for the group ranged from 86 to 130, the average being 116. The diastolic pressure ranged from 58 to 90, the average being 73. As stated, the average age of the patients in this group was 17 years.

A positive blood Wassermann reaction was present in only one case. This patient presented no other signs or symptoms indicative of a syphilitic infection.

SUMMARY

Two groups, one comprising fifty patients with a history of feeble-minded ancestors and the other composed of a like number of patients having an unimpaired heredity, were studied comparatively with respect to etiology, intelligence, physical growth and physical defects and diseases.

Etiology.—A history of possible etiologic significance other than heredity was found in eight patients belonging to the hereditary group and in thirty-one belonging to the nonhereditary group. In only one of the eight patients in the hereditary group does the physical condition warrant the assumption of the stated factor as a legitimate cause for the stunted intellectual growth.

In the nonhereditary group there was a direct relation between the physical condition as found at the present time and the so-called causative factor in fifteen of the thirty-one patients who gave a history of influences of etiologic significance. It would seem within reason to consider these fifteen patients as having a plausible explanation for their mental defectiveness.

It is to be noted that in all but three of these cases the assumed causative factor was of neurologic significance. The other three seemed to depend on an internal glandular imbalance.

Intelligence.—The distribution of intelligence for the two groups is of considerable interest. The average intelligence quotient of the hereditary group, fifty-six, was fifteen points higher than that of the nonhereditary group, which was forty-one. In the former group there were no idiots; five were imbeciles, thirty-five were morons and ten were borderline types. In the latter group there were twelve idiots, twelve imbeciles, twenty-four morons and only two belonging to the borderline type.

It may be added, generally speaking, that the patients with neurologic defects and diseases had a grade of intelligence corresponding to that of the idiot and lower imbecile group.

TABLE 1.—HEIGHT AND WEIGHT OF PATIENTS EXAMINED *

	Height, Inches	Weight, Pounds	Compared with Hereditary Group		Compared with Nonhereditary Group	
			Height, Inches	Weight, Pounds	Height, Inches	Weight, Pounds
Hereditary Group:						
Males.....	56.1	83.3	—1.6	—8.6
Females.....	56.6	91.0	—6.4	—31.0
Nonhereditary Group:						
Males.....	57.7	91.9	+1.6	+8.6		
Females.....	63.0	122.0	+6.4	+31.0		
Normal:						
Males.....	58.4	99.7	+2.3	+10.4	+0.7	+1.8
Females.....	58.9	100.4	+2.3	+9.4	—4.1	—21.6

TABLE 2.—PHYSICAL DEFECTS AND DISEASES

	Hereditary Cases	Nonhereditary Cases
None.....	24	20
Rickets.....	3	5
Hereditary syphilis.....	2	1
Pulmonary tuberculosis.....	5	3
Heart disease.....	1	2
Endocrinopathies.....	15	14
Neurologic diseases.....	3	11

Physical Growth and Development.—This is represented in a general way by the height and weight attained. The heights and weights of patients belonging to the hereditary group were consistently quite below those of the normal for the same ages, while the heights and weights of patients with a negative heredity were not appreciably below normal and in many cases exceeded those of the normal.

Relative to the average height, the males of the hereditary group were 2½ inches shorter than the normal average for the same ages, while the males of the nonhereditary group were less than 1 inch shorter than the normal. The females of the former group were 2½ inches shorter than the normal average, while those of the latter group were 4 inches above the normal average.

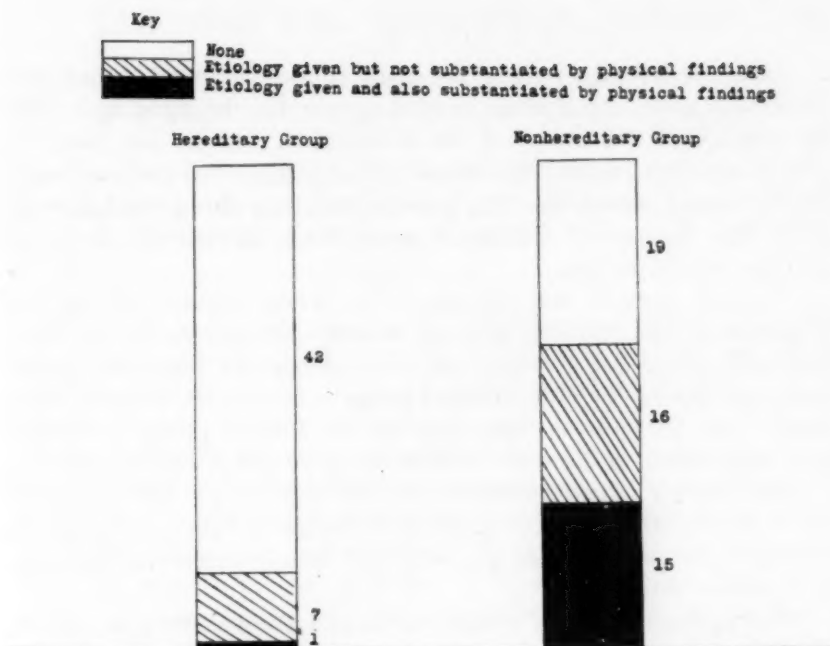


Chart 1.—Etiology of mental defect in the two groups studied.

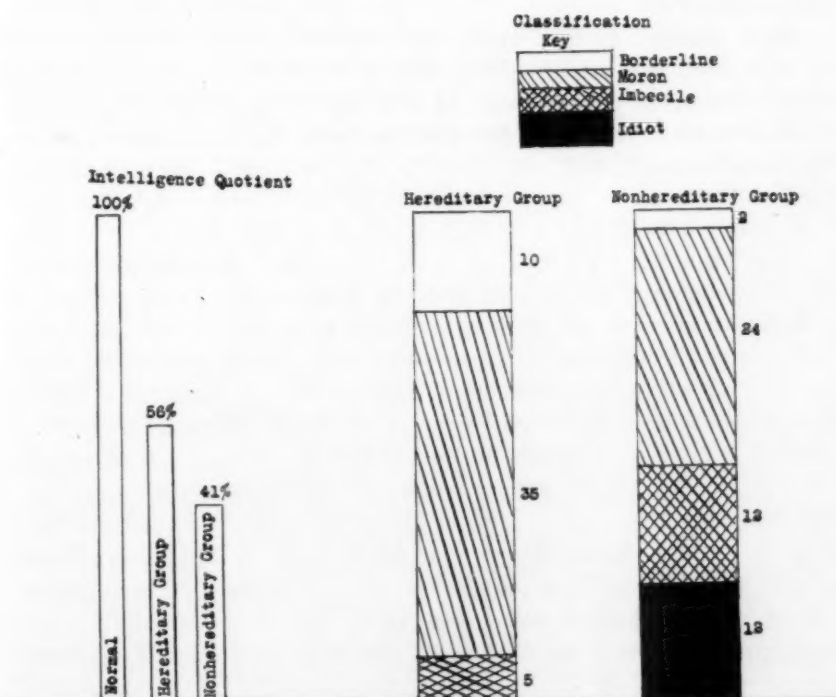


Chart 2.—Results of intelligence tests in patients studied.

As to the average weight, the males of the hereditary group were 10 pounds under the average normal weight for the same ages, while the average of the males of the nonhereditary group was only $1\frac{1}{2}$ pounds less than the normal average. The average weight of the females of the former group was $9\frac{1}{2}$ pounds less than the normal average, while the females of the latter group were 22 pounds above the average normal weight.

Physical Defects and Disease.—The whole number of the two respective groups showing physical defects and diseases did not differ materially, there being twenty-six cases among the hereditary group, and thirty among the nonhereditary group. On analysis, however, there were only three cases belonging to the former group showing a neurologic defect or disorder, while in the latter group were eleven cases.

One further salient feature is the fact that among 100 cases, over one half of them showed some physical disease or defect. Among this number were not included patients with minor defects of the eyes, ears, nose or throat.

This preliminary study would tend to indicate that there are decided differences between hereditary types of mental deficiency and those cases which for want of a better term might be called sporadic. Conclusions based on the foregoing findings would be unwarranted and quite unscientific.

It is planned to take up a more elaborate study along lines such as have been indicated in this paper of a number of cases sufficiently large to warrant conclusions. If this superficial study serves only to promote similar researches by other workers, one of its chief purposes has been accomplished.

A CASE OF AMBULATORY AUTOMATISM *

H. DOUGLAS SINGER, M.D. M.R.C.P.

Professor of Psychiatry and Head of Divisions of Neurology and Psychiatry,
College of Medicine, University of Illinois

CHICAGO

This case is deemed worthy of report because of the remarkable history of fugues, which occupied almost five of the last fifteen years, in two attacks of which the patient married. Memory for the periods of automatism was recovered without hypnosis, although the patient repeatedly went into a hypnoidal state when the free association method was used. The following is an example of the replies received in this state. In association with the name Ac., which it was known had been adopted in earlier fugues, he said "Seems to be natural . . . another person altogether . . . the name seems right. . . . I see him in a big store as a clerk. . . . He used to drink . . . not to excess . . . worked all the time, too. . . . The first time I met him in Colorado . . . stayed there a long time and went to Wyoming. . . . There is some connection with Reid Murdoch.¹ . . . ("Think of Reid Murdoch.") There's a blank wall there . . . a basement with all kinds of labels. . . . See all them cases I'm trying to read them . . . peaches, Monarch peaches . . . the first time they ever handled them. . . . What makes me say that? . . . All you hear in that store is Ac. Ac., have you got this and have you got that, all the peas . . . sifted and extra sifted . . . Shreveport ginger ale. . . . It begins to hurt . . . something seems to be pressing against my brain. . . . ("Well?") I was going to say something but I don't know what it was, I don't remember." The following day he was again asked to think of Ac. and began talking of cases of grocery goods. He was asked, "Where does it seem to be?" "West some place . . . there's mountains all round it. . . . ("Do you recognize them?") They're familiar but I don't know what the name is . . . lots and lots of sheep. . . . ("What is the name on the store?") No name on the front of it . . . a concrete building . . . a big place . . . all kinds of automobiles going by . . . from all over the country . . . going to Yellowstone Park. . . . ("The name of the street?") Yellowstone Highway. . . . (His head rolled around, and he stared in front of him.) You know the guys told me to hold up my hands

* Read before the Chicago Neurological Society, Oct. 19, 1922.

1. A firm of wholesale grocers.

. . . that was in . . . Trinidad, Colorado." Later in this same conversation when asked how long he had been in Trinidad, he said, "I was always there" and gave his name as John Ac. He also said that the hold-up was "Yesterday, I guess . . . No, I'm home now, aint I?"

On waking from these states to full consciousness he remembered fully what had been said. It would take altogether too long to record the memories in the way they were recovered, and hence the material has been rearranged. No effort was made to recover the memories of some of the fugues and there are gaps in the last one.

REPORT OF CASE

History.—John P. Ab. was born in Chicago of Swedish parents, in 1881. The father had been a sailor before settling in Chicago and often talked to the patient of his travels. The family history was at first said to be negative, but in a dream analysis it was learned that a cousin of the father drank too much and often wandered away for a week or ten days at a time probably "to sober up rather than to wander like I do." A cousin of the mother also disappeared when the patient was 12, taking with him money that did not belong to him, and he has not since been heard from.

John was a sickly child until the age of 4. As a boy he was active, normally mischievous, fond of all games and always a leader. The home life was happy, though somewhat austere religious. Punishments were rare, the only whipping being for smoking cigarets at the age of 14. He remembered no dreams or night terrors and repeatedly asserted that he "was never afraid of anything." He was an average scholar in most subjects but "always at the top of the class in history." He completed the eighth grade at the age of 15, having been retarded by frequent change of residence. He recalled no heroes either in fact or fiction, but read with fascination everything he could find on travel and adventure. He did not care for the society of girls, but denied any feeling of bashfulness or discomfort when with them.

On leaving school he worked for his father in the fish business for three years and then became messenger in a bank. After about a year he had an attack of appendicitis for which an operation was performed. On recovering, attracted by the opportunity for travel, he enlisted in the United States Navy, in 1901. Here he was very happy, studied hard and was well thought of by officers and fellows. Before discharge he had been promoted to coxswain and had passed the examination for the grade of boatswain's mate.

In 1903, he developed tuberculous adenitis of the neck and during the next two years five or six operations were performed, a purulent discharge continuing throughout. The final operation was performed in 1905, with entire success. At this time, however, he had evidence of pulmonary infection with hemoptysis. He was retained in the navy for a few months as shipkeeper in a navy yard, and was then discharged with a pension of \$6 a month and a prophecy of death within three months.

According to his statements, he received as treatment for the tuberculosis, about a pint of whisky with cod liver oil and nux vomica daily. In addition, he secured elsewhere another pint of whisky so that for a long time he was taking about a quart of whisky daily. Prior to this illness he had hardly tasted whisky, though he drank beer occasionally. Throughout this period he

mingled little with women, always preferring the society of men. He denied, however, any feeling of bashfulness, and occasionally had relations with women. Venereal infection was denied.

The discharge from the navy was a bitter disappointment, and he felt that he was badly treated in the matter of pension and also in the operative work on his neck. He went first to Nebraska and Colorado but became worse. He then lived in Bovina, Texas, with a man to cook and care for him. He continued to drink whisky in large quantities for several months and was twice found drunk in the basement of the house. He then decided to give it up entirely, and though there was a severe craving, succeeded in doing so. His health steadily improved, and in the following summer, 1906, he weighed 160 pounds (72.5 kg.). He made many friends in Bovina and the neighboring ranches. During this summer he injured his urethra while riding a bucking broncho. Sounds were passed and a false passage established which gave him much trouble during the following seven or eight years.

Two months after the accident there was an exacerbation of the tuberculosis, with high fever and hemoptysis, and he was much upset by the assertion of the physician that an operation would be necessary on the other side of his neck. He, however, improved without operation, and gradually resumed a more active life. About one month after getting out of bed, he suddenly left home one night on his first fugue and came to himself two or three days later in a railroad wreck on the Santa Fé at Attica, Kan. For a long time no memories in connection with this episode could be revived. During the study he repeatedly told stories, remembered during the night, of occasions when he had seen persons killed. These memories had not been recalled in many years. Finally, it was learned that just one week before the fugue a man was shot down close beside him, and, much shocked, he drove home as fast as he could. On the day of the fugue he was on the prairie shooting and accidentally shot the friend who was with him, causing him to lose consciousness but not seriously injuring him. He was much frightened and drove furiously about 20 miles to a physician. On arriving, he was so exhausted that the physician gave him a drink of whisky, the first he had drunk in many months. That same night he left home, went to a neighboring town and drank heavily. He did not know where he was going when the train was wrecked.

Following this episode he returned to Bovina and rapidly improved in health. He then started to work for his brothers in a real estate business in Texas and Kansas. He became an excellent salesman and was very popular everywhere. But he began to have periodic spells of drinking which would start suddenly, usually preceded by a "blinding headache." They lasted from a day to a week or more, and then he would not drink again perhaps for months. In them it is not clear that he really lost himself prior to the next incident.

Early in July, 1907, he returned to the Chicago office from a successful selling trip. On the train he had a severe headache. On arrival in Chicago on a Friday morning he had breakfast and went to the office, where he turned in his money and settled his accounts. Feeling sick, he went to his mother's home in the afternoon and lay down. He knew nothing from then until the following Tuesday morning when he awoke in a hotel in Chicago. With him was a woman, and after some questioning he learned that he had married her at Crown Point (a nearby town) on the preceding Friday evening. He had known the woman for about six months and had occasionally

taken her to shows when he was in town. She was entirely respectable and he liked her, but he had never had any thought of marrying her, and he was much horrified at what had happened.

Later he remembered that he had been drinking heavily on the way home, having spent the whole day Thursday drinking in St. Louis. On reaching Chicago he had a drink before breakfast and several more during the morning, though he was not drunk. He also recalled that he had telephoned to the girl and made an appointment with her for the evening.

Following the discovery of his marriage he accepted the situation with apparent resignation and attributed it to drink. He introduced his wife to his relatives, but continued to drink, and three weeks later was taken to a hospital with "delirium tremens." On recovering, he went to his mother's home and to bed. This was in August, 1907. The next thing he remembered was finding himself in a hospital in Topeka, Kan., with "malaria," about Christmas, 1907. He was told that he had been found in a delirious state at the depot and taken to the hospital. Following this fugue, which was not studied further, he returned to Bovina and resumed work for his brothers, but did not attempt to see his wife. He stayed there for about a year and then, at the instigation of his eldest brother, visited his wife, and they agreed to live together. He furnished a home in a small town in Texas where they lived for about a year (1909), during which a son was born. The relationship was not congenial, and he had several drinking spells, in some of which he acted with wild extravagance and abandon. In 1910, his wife had an attack of typhoid fever, and the baby was sick. When convalescent she visited relatives in Chicago, and then refused to return to Texas. Finally, she moved away, and he lost track of her altogether.

For a time Ab. continued to work in Texas but, following his father's funeral in Chicago, he suddenly disappeared again about March, 1911, and came to himself two months later in New York City. He wired to his brother who came for him, and they stayed there for about a week, when John again disappeared. He was gone nine months; he came to himself in a small town in North Carolina, where he found that he had been working for practically the whole period of the absence, under his own name, as foreman of a construction gang in the building of a dam. He learned that he had done good work and was well liked, but had been drinking "something scandalous."

He returned to work for his brothers and had another short "absence" during 1912. In February, 1913, while in Mercedes, Texas, he received a telegram calling him to Chicago on account of the serious illness of his eldest brother, to whom he was deeply attached. He started at once, caught a train at Harlingen, but left it during the night somewhere before reaching Houston. He came partially to himself two or three months later in a hospital in Pine Bluff, Ark., again with "malaria." It was later learned that after leaving the train he had gone to Dallas and from there to Texarcana, where he opened an office for real estate work. When he left the hospital at Pine Bluff he was very much puzzled and could not entirely remember his past, but he found in his pocket letters addressed to himself at Texarcana. He therefore went there, and, finding himself accepted without question, carried on the work. About two weeks later, while inspecting some timber, he suddenly had a vivid "vision" in which he saw his "brother's funeral." This was so real and affected him so strongly that he drove 16 miles into town and telegraphed home asking about his brother. On receiving word that the brother was dead and buried, the memory of the earlier message

returned, and he proceeded at once to Chicago. It is of interest to note that during this fugue he had gone to Pine Bluff on business, and while there he had been introduced to a woman whom he married about eighteen months later.

After visiting Chicago, where he had some trouble with his brothers about financial matters, he went to a ranch in West Texas to recuperate, where he remained for about nine months. The trouble with his brothers then became more acute, and he decided to go into business for himself. He went to Pine Bluff, which he had frequently visited before, and after working for several months in saw mills, finally purchased one. During this time, early in 1914, he again met, accidentally, the woman he was to marry, at once recognized her and remembered her name, although his previous acquaintance with her was during a fugue. In June, 1914, he secured a divorce from his first wife, and in September married again.

Three weeks after the marriage, he was injured at the mill, several ribs being broken. This kept him from work, and he felt miserable and ill. Three weeks after the injury he disappeared from the hotel where he was living and came to himself ten days later in a hospital in Birmingham, Ala., where he had been registered for nine days under the name of John P. Ac. This was the first occasion on which, so far as he knew, he had ever assumed another name, although the initials were the same as his own. According to his story, he was paralyzed when he came to himself, but rapidly regained the use of his legs. The account received from the hospital stated that there was no record of any paralysis, but that he was admitted on Nov. 27, 1914, complaining of severe pain in the back and loins, so severe that he was "unable to walk." He had a traumatic, urethral stricture with retention of urine, and internal urethrotomy was performed. Later it was found that the right ureter was obstructed and there was great swelling of the right kidney, a further operation was performed in which the kidney was decapsulated.

It is worthy of note that though he remained in the hospital from Nov. 27 to Feb. 14, 1915, his wife of a few weeks did not once visit him, and on leaving the hospital he went to Florida for several weeks without seeing her. He said, however, that their relations were of the best, and he heard from her regularly.

On leaving Florida he rejoined his wife in Pine Bluff; shortly afterward they moved to Louisiana and lived with his wife's parents. Here he grew stronger and again started in real estate work. He was not happy, however, and complained that his wife's relatives sponged on him and spent all he could earn. A daughter was born in October, 1916. They stayed until the Pershing expedition into Mexico when John secured a position in the Materials Inspection Corps and was sent to El Paso. Here his wife joined him after a few months, and later they were transferred to Deming, N. M., where they remained until the corps was disbanded in 1917. On the entrance of the United States into the World War, John tried to enlist but was rejected. He secured a position as lumber inspector in camp construction work and was sent to Nashville, Tenn., in October, 1917. Here he rented a home and drove out daily to the camp, about 20 miles away. He asserted that he was happy here but found his work hard and the responsibilities, especially in the hiring and supervision of a number of men, very irksome. He felt, however, that it was his duty to continue with it. A second baby was born in March, 1918. In July, the home was quarantined for measles, and then his wife developed appendicitis for which operation was necessary. One morning in

August, shortly after the return of his wife from the hospital, he started for work as usual at about 5:30. He had trouble with the carburetor of his car and twice got out to adjust it. From then he remembered nothing until Oct. 25, 1918, when he came to himself on Boston Common with a bundle of laundry under his arm. He felt dazed and very ill, appealed to the police for help, after inquiring as to his whereabouts, and was taken to the psychopathic hospital. The records of that hospital state that no disease was found; he was an attractive person, and his mental condition appeared normal except for a specific amnesia for the preceding two months. He also gave a good history of his life with amnesic periods as outlined in the foregoing. No success was achieved in penetrating these periods, and efforts at hypnosis were unsuccessful.

The first contact with the memories of this period came accidentally in connection with a discussion as to the date of enforcement of prohibition. The patient, without hesitation, said that he was in Wilmington, Del., at that time and then said "But I have never been in Wilmington!" Later in a hypnoidal state the following account was obtained: On the morning following the trouble with his car in Nashville, he was in Louisville, Ky.; he remembered coming from the station but not anything before that. He was without a coat, his shirt was torn and his trousers were very dirty, so that a man he spoke to remarked that he "must have been on a hell of a tear last night to get in that shape." He had \$380 in \$20 bills and \$5 or \$6 in smaller change in his pockets. When he left home in Nashville, he had \$400 in \$20 bills with which he proposed to pay a debt. A bandage, which looked as if it "must have been applied by a doctor or a nurse," was on his left arm over a long cut. He had severe pain in his chest, which hurt when he breathed, and he could not lift anything. When he went to a physician a few days later, it was found that he had some broken ribs. On returning to Nashville, after leaving Boston, he learned that his car had been picked up from a ditch at the side of the road about 3 miles from the city; the hind end was "all stove in," and one wheel was smashed. Taken together, these suggest that the patient had been in an accident, though he has no recollection of it at all and does not know how he got to the station or to Louisville.

At Louisville he secured work for the government under the name Ac. as an assistant in building inspection. He was sent first to Norfolk, Va., and then in succession to Newport News, Wilmington, New York, New Haven and Boston. He recalled where he had worked and stayed in each place. On reaching Boston, he was feeling sick, went to a hotel and lay down for a time. The next event remembered was coming to himself on the Common.

After a stay of a few weeks in Boston he returned to Nashville but did not work for three or four months. He then secured a position in Michigan, where he stayed for about a year. He did not like the routine life he had to lead and was anxious to get into business for himself; he therefore resigned and again went to live with his wife's folks in Louisiana. Here he started buying and selling oil leases and had some financial disappointment due, he said, to "trusting people" too much. In the fall of 1919, he heard that his mother in Chicago was not well and came to visit her bringing with him his elder child. He stayed a few days and then returned to Louisiana. The child became ill on the train, and this worried him a great deal. Shortly after reaching home he went to Shreveport in connection with an oil deal in which he felt he had been cheated, and from that time remembered noth-

ing until June 10 or 12, 1922, a period of more than two and a half years, when he came to himself lying in a box car at Des Moines, N. M., with his head cut open and his pockets turned inside out. As a matter of fact he had been told by his brother, who had learned from the wife, that the family had moved from Louisiana to Houston, Texas, and had lived there about three months before he actually disappeared, but of this John had no recollection. It is also of interest to learn that, to his surprise, when he came to himself he was wearing the ring and button of a secret order without the least knowledge as to where he had acquired them.

At Des Moines he felt hazy; the world seemed strange, and he was afraid to speak to people lest they think him insane. He slept a great deal and was ravenously hungry when awake. He spent the first three days at a ranch, and then started to walk and work his way to Chicago, taking advantage of rides proffered by passing motorists. It was not until he reached Wichita, Kan., where he had once spent some months, more than a week later, that he fully realized who he was. In passing through Kansas City he happened to notice the hall of the secret order whose insignia he was wearing. Moved by impulse, he went in to find that he knew the whole ritual. Even this failed to bring back any recollection of where he had learned it. He reached Chicago about six weeks after coming to himself, and went at once to see Dr. Edward Ochsner, who kindly referred him to me.

The memories of this period recovered in the analysis were as follows: When he went to Shreveport he had severe headache and felt worried and ill. After finding that he could do nothing to straighten out the oil deal, he wandered without definite aim to St. Charles, La., Beaumont, Galveston, Albion, Kingsville, and Brownsville, Tex., during the next three weeks, feeling despondent and suffering severely with headache. He then remembered that his wife did not know where he was, telegraphed her and went home. They then moved to Houston, where he felt too ill to work. He tried to obtain relief at the station of the Veterans' Bureau and wrote several letters to Washington, but was refused hospitalization. Then there was a period probably of about a week, the memories for which could not be revived. He next recalled a hotel in Dallas where he was under the care of a physician and registered by the name of John P. Ac. With him in his room was a woman who "seemed" to be taking care of him; he was unable to recall her name. After a few days he was better and managed to sell some blank oil leases which he had in his pocket, thereby securing about \$500. He did not worry about his past, he felt as if he had always been there, and accepted himself without question. At this time, he and the woman who had at first been taking care of him were living as man and wife. He was not sure, but he did not think they were married. He bought himself clothes and a suitcase and with Mrs. Ac., the name by which she went (the only other name he can recall is Honey), went to Amarilla; after a week he decided to go West. They went to Trinidad, Colo.; why is not clear, but probably because he heard of a job there. He secured a position as clerk and later stock-keeper in a wholesale grocery house, and he worked there for a year. He lived with Mrs. Ac. in a suburb four or five miles from the city, made a number of friends, and was here initiated into the secret order. He recalled that in applying for his position he stated that he was born in Chicago, that his parents were dead, and that he had been married before, his wife and two children being dead. As reference he gave his service in the navy and the work for the government during the Mexican trouble, although these memories of course belong to Ab. He was happy here, got along well

with Mrs. Ac., but drank a good deal. After a year he secured, through an advertisement, a better position in a grocery house at Casper, Wyo., where he worked for a year and a half and gave, as letters from the firm testify, excellent service. Then, not feeling well, he took a vacation with Mrs. Ac. and went to Trinidad, where they stayed for two weeks. He had been dabbling in oil leases, and on the day before he intended to return to Casper sold some for \$600. With this roll in his pocket he started for the station to buy transportation for the return at 5 the next morning. On the way he went into a saloon and bought a drink, flashing his roll of bills. Two men in the saloon left before he did and when he came out held him up, one of them striking him on the head with a gun and rendering him unconscious. The next memory is that of finding himself in the box car at Des Moines, N. M., with a growth of beard which suggested that he had been in the car for at least two days, ample time for the train journey between the two places.

With regard to the conditions which led up to this fugue, the memories for which were the last to return, it was learned that while in Louisiana, he discovered that his wife was corresponding with another man whom they had known since the days in Nashville. This worried him greatly, and, not knowing what to do, he wandered about in a dazed condition and finally moved with his family to Houston. There he saw a letter which was altogether "too familiar," quarreled with his wife and then disappeared. The truth of this story is established by the facts that after his disappearance the wife secured a divorce in the shortest time possible and married the man in question.

Examination.—Ab. presented no evidence of active disease, though the scars in the neck and thorax bore witness to the old tuberculosis. He was bright, alert, energetic and decidedly attractive. He was highly sensitive; tears were often observed in his eyes, emotional but not demonstrative. In spite of his roving life he appeared refined; he was courteous, and there was an entire absence of oaths or coarseness in his language. He was highly imaginative optimistic and easily became enthusiastic over plans for his future, especially in the oil business. He passed lightly over his failures and handicaps, and his judgment often appeared decidedly naive and childlike. During the earlier interviews, he frequently insisted on his lack of fear and his love for the adventurous, but when this was finally challenged and his tendency to run away emphasized, he admitted the truth of this contention, and then adduced occasions on which he had been very much frightened. It is also striking that he had had practically no quarrels or fights. The strong attachments of his life have been for his mother and deceased, eldest brother, both of whom have greatly aided and protected him. Outside the states of automatism, his relations with the opposite sex appear to have been decidedly conventional and not extremely ardent, but he was natural in his appetites and sex relationships. In the automatic states, especially when drinking, he was often a libertine.

During the analysis, he twice had recurrences of the "blinding headaches" which usually preceded the fugues. On one of these occasions, after recovering and refusing to communicate the memory of the existence of Mrs. Ac., he even started again on a fugue. He had gone to bed with a headache at 11:45, and at 12:15 found himself, fully dressed, in the kitchen on the way out of the house. He had a struggle before deciding to stay at home. It is also of interest to note that toward the end of the study he expressed himself as feeling, for the first time in many years, a "whole man"; and he wrote

spontaneously to Colorado to find out what had become of Mrs. Ac., to whom he realized he owed some adjustment, although at first his intention was to ignore this part of his life.

SUMMARY

The outstanding features of the personality of this patient are restless energy combined with a sensitive, timorous conventionality. Coupled with the associations of childhood, the former led to a craving for change and adventure which was held in check by the latter. The navy offered prospects of a successful compromise, which was shattered by illness with resultant intense resentment. At the same time alcohol was offered as a substitute and served for a time to allay the disappointment. With returning health this was discontinued, but a recurrence of the illness and its accompanying fears, serious psychic trauma, exhaustion and an accidental dose of whisky led to an effort to escape by a blind return to excessive drinking. Following this first fugue, the craving for excitement and escape from the trammels of his conventional inhibitions reappeared at intervals; and a feeling of illness offered a justification for resorting to alcohol, under the influence of which he gave way to sexual excesses, and finally married. To escape the consequences, he first drank until he developed delirium tremens, and then disappeared on a prolonged fugue. Subsequent difficulties have been reacted to in the same manner. The nature of these difficulties is sufficiently indicated in the foregoing detailed account and need not be further discussed here. It will be noted, however, that in many of the fugues there has been a concomitance with illness or injury as at the first attack. The reason for the recovery of the real personality is not always clear, but has usually been the presence of an illness or an accidental injury.

COMMENT

The mechanism underlying the condition seems thus to be quite clearly an escape from some situation intolerable to the sensitive personality, and thus brings the case under the category of psychoneuroses of hysterical type. The prolonged duration of the fugues and the ease with which the memories were recovered preclude any possibility of epilepsy.

DISCUSSION

DR. HUGH T. PATRICK: I think this is the first case of the kind reported to this society. The subject of fugues is a large one. There are various kinds occurring in several mental disorders, but in the type represented by Dr. Singer's case, I think it is clear that the patient is running away from something. He cannot adjust himself to the fight; he can neither dominate conditions nor endure them, so he runs away. The fact that he runs away in this state of secondary consciousness instead of consciously is due to his temperament or disposition plus his experience or training, just as some persons get out of difficulties by means of hysterical paralysis or hysterical fits. The reaction of

his particular temperament is to pass into a state of secondary consciousness and get away from trouble. Temperament and training probably also determine why these states of secondary consciousness last so long in some people and so short a time in others. Every one of ten or a dozen patients I have seen was escaping from something he did not like: financial difficulties, honest or dishonest, domestic troubles, irksome responsibility, punishment for petty crimes. One patient was, as nearly as I could find out, running away from a headache, and in Dr. Singer's case one of the first symptoms was headache. In some patients, alcohol seems to start the fugues. When sober they behave, but after a drinking bout they have a fugue. One case was that of a younger son of an English family who had traveled all over the continent while having fugues. He seldom went away for long periods unless he had been drinking. When I saw him he had come to himself, after a fashion, at a busy corner in Chicago. He stopped a policeman and asked him where he was, and the policeman named the corner. He then said, "What city is this?" When told he next asked what his (the patient's) name was. The policeman was inclined to be irritated, but then saw that there was something wrong with the man and took him to a hospital, and it was a long time before he could remember his name. After he had been in the hospital for some time he told us a name. It proved not to be his name. After a week or so he said, "Now I know my name," and gave a totally different name, but nothing could be found to connect him with this name. After a few days he still insisted that that was his name and recalled a Chicago man with whom he had gone to college. I called up this man, and he said he had never known such a man at college. I took the message back to the patient who was puzzled and indignant and said, "Of course he knows me; now you go tell him about the time he and I and A—— B——, did so and so," relating in detail a college escapade. The Chicagoan remembered the incident very well but said the third man was X—— Y——. On receiving the message the patient said, "Of course, *that's* my name!" and we then traced his relationship and found out who he was. That fugue started in an intoxicated state. He had been attending the international yacht races, had been drinking a lot of champagne, and the next thing he knew he found himself in Chicago. He always had something to run away from; he was always in trouble from indulging in more or less irresponsible irregularities. I have never had a case with such long absences as the one reported by Dr. Singer, although there are many in the literature.

Some years ago I had occasion to look up the literature rather fully, and the conclusion that I came to, and which I feel certain is right, is that an epileptic fugue is always exceedingly brief. I do not believe that ambulatory automatism due to epilepsy ever lasts more than a few hours, certainly not more than one day; that is, a fugue in which the patient acts in a natural and normal way. One of the very early cases is one reported by Charcot, but after a study of his report and the reports of others subsequently on the same case, it seemed clear that it was not an epileptic case at all. I was unable to find in the literature a single conclusive case of epileptic ambulatory automatism, or what seemed to me to be that, that lasted more than a few hours. I have never had one in my own experience. I should be very much pleased to have Dr. Singer's opinion on this point.

DR. PETER BASSOE: I was struck by the history of headaches in this case which recalls the possible relationship between the three conditions: migraine, alcoholism and epilepsy. We all know that Kraepelin looked on dipsomania as

a form of epilepsy, and I would like to ask Dr. Singer whether it might be assumed that these fugues were a sort of epileptic equivalent. Then the only peculiar thing would be their long duration.

DR. HERMAN M. ADLER: I think one thing should be emphasized: I believe that we all agree with Dr. Patrick that this case is one of an attempt to escape, but it is important to note that it is an attempt to escape from something in the person himself and not from something outside of himself. Dr. A. W. Stearns has recently shown in his work on suicide that suicide may be interpreted as an attempt to escape from the ego. It is interesting to note that in Dr. Singer's case we are dealing with an intelligent and very sensitive person. This is according to the general rule, that the more intelligent and sensitive the patient, the more likely he is to find intolerable situations. One would expect to find such conditions rather frequently among criminals, yet that does not seem to be the case. Not infrequently some of our prisoners present a good imitation of fugue, but we are able to analyze the case and find that it is one of shamming rather than a true fugue. Of course, there are a few cases in which a true fugue occurs. Criminals, as a rule, are not sensitive, even though they may be intelligent.

DR. H. DOUGLAS SINGER: The question of epilepsy has been fairly well covered. I may add that the memories of a period of epileptic automatism are extremely difficult, if not impossible, to recover. In this man such recovery was easy. He readily passed into a hypnoidal state, though many memories were revived during full waking consciousness.

The view expressed by Dr. Patrick is well illustrated by a case seen recently in the Cook County Hospital. A boy was brought in by the police who did not know a thing about himself. His past was an absolute blank. I saw him the day he was brought in, and after a few simple questions on school knowledge happened to ask the right question, "What are you trying to forget?" He stared at me, tears appeared in his eyes and he said, "Now I remember! My girl has just turned me down." He still maintained that he did not know his name or past, and I gave him five minutes to think. When I returned he had recovered full memory. About a year before he had been gambling, had borrowed money, was put on probation in the Boy's Court and ordered to repay in weekly installments. He succeeded until he fell in love and wanted to spend money on the girl. She, in some way, learned the story and "turned him down." In his fugue the same day, he was trying to forget the whole situation.

I can see no advantage in attempting to connect such episodes with epilepsy. In the case here reported the fugues, including the headaches and alcoholism, seem to be clearly efforts to escape from intolerable situations by ignoring them, a mode of reaction to which some types of personality are more liable than others, particularly, as Dr. Adler says, the sensitive timidity so well illustrated by this patient.

BASAL METABOLISM IN MENTAL DISEASE *

K. M. BOWMAN, M.D., AND G. P. GRABFIELD, M.D.

BOSTON

Heretofore variations in basal metabolism have been considered essentially as an index of the activity of the thyroid gland. We have correlated a series of fifty cases in which tabulations were made and which for the most part showed no clinical evidence of thyroid disease.

Great stress has been laid in the past on the finding of an increased metabolic rate associated with hyperthyroidism. In the present group of cases, which are unselected, a striking feature is the predominance of low metabolic rates. The significance of this rate is undetermined, and we present these data without venturing to interpret them.

The apparatus used in these investigations is the so-called "Benedict portable" manufactured by W. E. Collins. This machine measures only the oxygen consumption. The sources of error in the use of this machine in our patients are: 1. Soda lime must be replaced frequently. 2. Leaks in the system must be looked for in every determination (in dealing with mental patients one must especially look for leaks around the mouth piece). 3. The cooperation of the patient must be carefully determined in regard to both activity and forced breathing.

In every case at least two determinations checking within 5 per cent. were used. The Du Bois formula was used in estimating the body surface.

Little has been written on the subject of basal metabolism in mental disease. In a recent article,¹ one of us has reported low basal metabolism in ten cases of dementia praecox. Kirby and Gibbs² likewise report a series of ten cases of dementia praecox and a number of manic-depressive cases of various types. In a large number of their cases readings were normal, but there was a definite tendency toward low readings. It is interesting that the only case in their series that gave a markedly high reading was a case of mixed type of manic-depressive psychosis.

In our series of fifty cases, only four showed increased basal metabolism, if we accept ± 10 per cent. as the normal variation. Three of these cases belonged to the manic-depressive group, two were cases

* From the Laboratory of Internal Medicine, Boston Psychopathic Hospital.

1. Bowman, K. M.; Eidson, J. P., and Burladge, S. P.: *Biochemical Studies in Ten Cases of Dementia Praecox*, Boston M. & S. J. **187**:10, 358 (Sept. 7) 1922.

2. Kirby, G. H., and Gibbs, C. E.: To appear in the *Archives of Internal Medicine*.

BASAL METABOLISM IN VARIOUS MENTAL DISEASES

Case No.	Pulse	Nutrition	Age	Sex	Basal Metabolism	Diagnosis
1415	74	W. N.	43	F	-25	Traumatic psychosis
2004	80	W. N.	21	F	-3	Psychosis with cerebral syphilis
2168	74	W. N.	47	M	-15	Psychosis with brain tumor
796	86	F. W. N.	49	F	-11	Psychosis with lethargic encephalitis
3533	72	W. N.	27	F	-21	Psychosis with lethargic encephalitis
3511	72	W. N.	29	F	-21	General paresis
		W. N.	67	M	-17	Psychosis with organic brain disease (type undetermined)
1768	100	F. W. N.	23	F	-17	Psychosis with organic brain disease (type undetermined)
1574	104	W. N.	14	F	-17	Postoperative delirium, partial thyroidectomy
1789	80	F. W. N.	30	F	-15	Manic-depressive mania
2856	120	W. N.	19	F	+2	Manic-depressive mania
1663	96	F. W. N.	21	M	+13; +2	Manic-depressive depression
3352	120	W. N.	19	F	-2; -10	Manic-depressive depression
1693	76	W. N.	19	M	+15	Manic-depressive depression
2475	76	W. N.	33	F	+77; +66; +40	Manic-depressive mixed
1286	94	P. N.	15	M	-24; -31; -37	Schizophrenia
2066	120	P. N.	14	M	-11	Schizophrenia
3370	78	W. N.	16	F	-20; -17	Schizophrenia
3464	84	W. N.	15	F	-14	Schizophrenia
3100	74	P. N.	24	M	-3	Schizophrenia
2281	80	W. N.	35	F	-5	Psychosis with mental deficiency
1874	100	W. N.	17	F	-8	Undiagnosed psychosis
3395	70	W. N.	40	F	-26; -27	Psychoneurosis; hysteria
3480	92	W. N.	21	F	-25	Psychoneurosis; hysteria
3469	82	W. N.	20	F	-6	Psychoneurosis; hysteria
3376	80	F. W. N.	28	M	-18	Psychoneurosis; neurasthenia
1549	84	W. N.	25	F	100	Psychoneurosis; anxiety type
2308	58	W. N.	40	M	-16	Psychoneurosis; anxiety type
1766	80	W. N.	26	F	-1	Psychoneurosis; anxiety type
1845	90	W. N.	20	F	-5	Psychoneurosis
2910	70	W. N.	21	F	-12; -18	Narcolepsy
		W. N.	12	F	-20	Epilepsy without psychosis
2417	68	W. N.	8	M	100	Epilepsy without psychosis
1878	74	W. N.	10	F	-21	Epilepsy without psychosis
3084	76	W. N.	19	M	-7	Epilepsy without psychosis
2177	72	W. N.	12	M	-20	Epilepsy without psychosis
2766	84	W. N.	21	F	+8	Epilepsy without psychosis
2328	76	F. W. N.	14	M	-13; -2	Psychopathic personality without psychosis
1933	80	W. N.	25	F	-6	Psychopathic personality without psychosis
2193	80	W. N.	19	M	-8	Psychopathic personality without psychosis
1455	84	W. N.	25	F	-14	Psychopathic personality without psychosis
964	74	W. N.	18	F	+15; +2	Psychopathic personality without psychosis
3104	90	W. N.	18	F	-12	Psychopathic personality without psychosis
3560	68	F. W. N.	23	F	-16	Psychopathic personality without psychosis
3266	88	W. N.	15	F	-5	Mental deficiency without psychosis
3069	96	W. N.	58	F	-6; -6	Mental deficiency and cretinism without psychosis
3072	80	W. N.	11	F	-6	Mental deficiency without psychosis
G 4	...	W. N.	50	F	-18	Myxedema
G 2	...	W. N.	45	F	-33	Myxedema
Q 5	...	W. N.	50	F	-17	Myxedema

of depression with readings of + 13 per cent. and + 2 per cent. in one case and + 15 per cent. in the other; one, a mixed type, had readings of + 77 per cent., + 66 per cent. and + 40 per cent. It is, perhaps, noteworthy that the only case in the entire series with a markedly increased basal metabolism was this case of the mixed type of manic-depressive psychosis, since Kirby and Gibbs found the same to be true in their series. The fourth case with a high reading was one of psychopathic personality without psychosis, in which the basal metabolism was + 15 per cent. and + 2 per cent. Two more cases had plus readings, but within normal limits, and two cases gave readings of exactly 100 per cent. The remaining forty-two cases all gave minus readings and twenty-seven of these, over half of the cases in the entire series, had a basal metabolism of less than — 10 per cent., which is commonly considered the lower limit of normal.

It seems worth while to call attention to the fact that eight out of nine patients with organic psychoses had abnormally low basal metabolism, that the tendency toward low basal metabolism previously reported in schizophrenia is confirmed by the few cases of this series, and that the manic-depressive group showed less tendency toward low readings than any other group.

We cannot but feel that this tendency toward a low basal metabolism in cases of mental disease is of importance and merits consideration in formulating our theories as to etiology and treatment. On the other hand, we do not feel that any conclusions are justifiable as yet. Careful physical examination and administration of thyroid extract by mouth or thyroxin intravenously have made us feel that simple hypothyroidism is not the explanation of the large number of cases of abnormally low basal metabolism. Kirby and Gibbs have reached the same conclusion. Further work along this line is being done, and we hope ultimately to settle this point. On the other hand, Lewis and Davis³ report that they found evidence of hypothyroidism in sixteen out of twenty-two cases of schizophrenia of from one to ten years' duration, and that following thyroid feeding, nineteen patients improved physically, four recovered mentally and were discharged, nine improved mentally and nine did not improve mentally.

Except as noted in the list of diagnoses, in no case were there physical findings which made us suspect endocrine disturbance.

Since inanition has some effect in lowering basal metabolism, we have recorded the degree of nutrition in each case in the table. *W. N.*

3. Lewis, N. D. C., and Davis, G. R.: A Correlative Study of Endocrine Imbalance and Mental Disease, *J. Nerv. & Ment. Dis.* **54**: No. 5; **54**: No. 6, and **55**: No. 1, 1921, 1922.

means well nourished; *F. W. N.*, fairly well nourished; *P. N.*, poorly nourished. It will be seen from a study of the table that only three cases showed sufficient inanition to affect the basal metabolism.

We have also recorded the pulse rate, age and sex in each case, feeling that they are of sufficient importance to warrant so doing.

Abstracts from Current Literature

THE ORIGIN OF PSYCHIC ENERGY. J. DANYSZ, Paris: J. B. Baillière et Fils, 1921. Abstract translation of pages 113-118.

It is well worth while for us who trudge or speed along special roads in the domain of biology, occasionally to take a journey across country into broad fields and across new roads. Many books are now written to guide us on such journeys, and of these Dr. Danysz' "Genesis of Psychic Energy" is of especial interest to neurologists. We probably will not agree in detail with his view of this genesis, but at least it is broadening and brings to mind possible neurologic bearings of recent advances in physics, chemistry, genetics, serology and anaphylaxis. For example, few of us will agree with his statement that "In an animal, a change caused by a factor from the exterior can only become durable and transmittable if it causes a new equilibrium in the functions of the endocrine glands." This may be the basis of creative evolution, but as yet there is not enough evidence to warrant such a statement. Nevertheless, the book contains enough stimulation to make it of definite value. A summarized translation follows:

Our conception of the constitution and evolution of the universe rests on the analysis and coordination of the following facts:

The universe is composed of a certain number of units: matter, distinct energy, which can be divided into two classes:

1. Units which seemed indivisible, whose duration used to be considered unlimited and whose structures appeared constant and invariable, namely, the atoms: hydrogen, oxygen, nitrogen, carbon, iron, etc.

2. Units which undergo incessant transformation and are influenced by the variation of their surroundings.

The discovery of radioactive bodies and the spectroscopic study of the stars has further subdivided atoms into electrons, with provision for a further subdivision into etherons, so that we can place the electron or the etheron at the base of progressive evolution as the unit of primordial matter-energy.

In the "necessary succession" in the formation of "matter-energy" units of greater and greater power by the reunion and coordination of more simple units into more complex ones in the inorganic world and by the multiplication and differentiation of cells in the living world, we consider the following factors to have been potent:

1. The gradual and continual lowering of the temperature in the inorganic period. This factor contributed toward selection of the less stable and more active elements which could only thus become the components of more complex units.

2. The formation of water into a liquid state on the surface of the earth and the progressive lowering of the temperature of this water to about 50 degrees was the factor in the second selection. The water acted as a solvent of different elements and compositions, in different proportions, and as a catalyser of dissolved and dissociated elements in the proportion in which they were necessary to form living matter. The formation of the first living units did not require the intervention of a special energy. It was the natural consequence of a series of selections which ended in the reunion

of the lightest elements and those richest in multiple affinities and capable of forming the less stable compositions. These, by the sole play of their affinities, aided by the catalysing properties of the water, were able to give birth to the first living micelles.

3. Once living beings are constituted, with an interior milieu of infinite complexity and with a great sensibility to all the actions of the exterior milieu, it is the radiating energies which become the most active factors in progressive evolution. They cause the formation of sense organs and, later, of nerve tissue.

4. This nerve tissue and its different forms of energy have brought this evolution up to man, that is, to a brain, in which the spheres of association have acquired a development dominating all the other parts of the encephalon. From the brain is derived a specific energy—psychic energy, which results from the coordinate cooperation of all the preceding “matter-energy” units, and which has become so powerful that it does not passively submit to the reactions of the exterior milieu, but which, having become conscious of itself, of its force and means of action, tries to intervene actively in the evolution of its interior milieu and to adapt to it the exterior milieu.

This evolution is progressive because, at each degree of complexity, the energetic power of the newly formed units augmented in ever increasing proportions, and this increase of power was a necessary consequence of the succession of the coordinated associations of all the preceding “matter-energy” units, which do not simply progress numerically, but organize for common action.

After the appearance of mammals, one of the most important factors in the continuity and rapidity of evolution was the constitution of an increasingly constant temperature in the interior milieu, an indispensable condition for a regular continuity of reactions and of a strong resistance to the disturbing influences of temperature variations in the exterior milieu.

From the preceding facts we can conclude that living matter, considered as a chemical composition, conforms to the general laws which determine the reactions of mineral matter composed of the same simple elements; considered as a physiologic unit, it obeys laws which are not exclusively within the domain of pure chemistry, mineral or molecular.

Each new unit formed by inorganic synthesis or by a biologic differentiation and endowed with a new form of energy has a right to a new name to characterize its structure as well as its function. In micelles chemical affinity does not obey the same laws as in molecules, and it would be foolish to call units endowed with different properties by the same name. Excepting colloids, which gave birth to the first albuminous micelles, and through them to living cells that we will call the first biologic units, we can assume that the first important factor in the progressive evolution of living matter was the formation of vitamins by protozoas and by vegetables. We have observed, as much as it is possible to judge by present experiments, that it is entirely due to vitamins that animals, which are incapable of producing them themselves, can assimilate the vegetable albumins and nourish themselves thus with substances already selected (and of a more elevated structure) and acquire from them a greater activity and plasticity, which permit them to submit to the influence of radiating energies and finally to differentiate nerve tissue.

The second determining factor was the formation, by differentiation, of “nerve tissue” first, of the peripheral organs of sense, then of nerve fibers, then of ganglions or nerve centers and finally, in these centers, of sensory

spheres and more and more complex and extended spheres of association. In proportion as organisms became more and more complex, because more finely differentiated, they became at the same time more and more sensitive to increasingly numerous and varied substances and forms of energy. Thus, nearly all living beings—animals, protozoas or vegetables—are nearly equally sensitive to simple crystalloids (acids, bases, salts); complex crystalloids (glucosids, alkaloids) are of a more selective action; they act only in a much larger dosage on vegetables and the lower animals than on the higher forms of animal life. Colloids probably provoke no appreciable reaction on saprophytic vegetables and react only slightly on unicellular beings, vegetable parasites and the lower animals. The formation of antibodies appears to cause important changes only in the higher vertebrates. Radiating energies only become dominant factors in evolution among animals with a differentiated nervous system, and their action is more pronounced (particularly that of light and sound) in proportion as the peripheral organ and the corresponding sensory center are more developed. The emotions do not begin to be felt and to react except on animals provided with a brain, and finally so-called thought, conscious will and its ends, appears and begins to react in an appreciable way on evolution only with the formation of the spheres of association in man. The appearance of thought marks the most important epoch in the process of progressive evolution, because this form of energy reacts not only on the evolution of the "matter-energy" unit man, on his interior milieu, but also, in an indirect way, on his entire exterior milieu, on all the "matter-energy" units which have preceded man.

Of course, all these actions and reactions have, as a starting point, physico-chemical reactions and end in other reactions of the same nature; it would be of the greatest interest to know their intimate mechanism. We know what goes into an organism and we can analyze what comes out, but we are in complete ignorance of what transformations each element undergoes and forms during its passage, because we do not know the intimate constitution of the physiologic unit of every living being, Darwin's gemmule, Elseberg's plastidule, de Vries' pangènes, Wiesner's plasome, Hertwig's idioblaste, Weissmann's biophore or déterminant, etc., in short, of the living albuminous micelle, which cannot, by its definition, have the same chemical composition nor the same structure as the dead albuminous micelle. Clarke has made wings grow on a wingless bug by watering the rose bushes with a little magnesium sulphate, and Stockard raised fish with one eye in the middle of their heads by adding a little chlorid of magnesium to the water, but we do not know the cause nor the mechanism.

It is all the more difficult to determine the cause of these extraordinary phenomena because other substances of a very different nature chemically can present the same effect. The only conclusions we can draw are that the effect probably results from a series of indirect reactions, the hyposecretion or hypersecretion of a gland which determines the formation of certain organs or tissues, or a combination of the foreign substances with the hormone or hormonozone already in the blood or humors. The effect produced will be temporary or permanent, the new character will be individual or hereditary according to whether the reaction provoked is more or less durable and whether it has exercised a corresponding change in the cells of reproduction. Organic colloids, albumins, by the formation of antibodies, cause the most durable changes in the organism: if the new equilibrium is favorable to the development of the individual, the race becomes powerful; if the contrary, the race

may disappear. The equilibrium among the various organs in an organism must be as perfect as possible in order that the individual and race may be strong.

Among the higher forms of animal life, every evolutionary reaction, ascending or descending, is effected either by the action of the nervous system, or (and this is the most frequent case) by the intermediation of the glands of internal secretion which regulate the conditions of nutrition and through that the development of all the other tissues and organs. In an animal, a change caused by a factor from the exterior can only become durable and transmittable if it causes a new equilibrium in the functions of the endocrine glands.

Summary.—All that we know today about the progressive evolution of living matter can be summed up in a few words:

Since the formation of the first biologic units of unicellular beings, living matter continues today to develop and to grow by the multiplication of unicellular organisms. Its continuous progressive evolution consists essentially in the progressive formation for this unicellular organism of an immediate milieu of evolution, increasingly differentiated and endowed, thanks to this increasing complexity, with an energy of its own, more and more powerful and becoming therefore at the same time more resistant, more stable and of a more delicate sensibility to the action of the ever variable elements in the exterior milieu. This evolution has been attained by the alternative formation and coordination of structures and of new forms of energy, step by step, in an uninterrupted fashion, through millions of centuries, in a spontaneous and unconscious way, up to man, who becomes more and more conscious of the mechanism of this evolution, of the biologic rôle of the imperishable unicellular organism and of its immediate milieu, the perishable individual.

And, thanks to this new energy, consciousness, resulting from the coordination of structures and from more and more differentiated energies, man seeks to intervene in the knowledge of cause and effects and in the future mechanism of this progressive evolution, to dominate and to conduct it with more security and certainty in the direction that it seems to be taking by itself. This is the direction that the knowledge of the past indicates as the only possible one: the unlimited growth of psychic energy and the unlimited differentiation of its organ, the brain.

Thus man has arrived at the conception of a definite aim for his efforts, an ideal for the future realizable from an unlimited evolution of the body and the spirit, because this evolution carries with it all the elements of an infinitely perfectable structural and energetic growth.

SUSAN E. HALE and STANLEY COBB, Boston.

DYSTONIA LENTICULARIS PROGRESSIVA. ARRIGO FRIGERIO, *Riv. di patol. nerv.* 27:1 (Oct. 15) 1922.

The author reports a clinical case in detail. The patient, aged 51, a Jew, who was quite alcoholic, began to show mental peculiarities in 1902. He had trouble in beginning speech, and syllable stuttering with slowness of speech was noted. There were vomiting, polyuria and polydipsia. In 1908, he complained of headaches, and one night he was found comatose on the doorsteps of his home. He was stuporous for twenty-four hours, and then he had an epileptiform convulsion lasting one-half hour. He recovered completely in a short time. The urine contained sugar at this time, and he was treated for diabetes, but this diagnosis was changed, and the patient was placed on

a full diet. Some time later he walked badly, stumbled and complained also of formication and pains in his legs, especially in the left knee. At this time the patient also noted fibrillary contractions in the muscles of the lower left extremity, and a gradually increasing atrophy. In February, 1921, his complaints were of the motor disturbances described later, and above all, severe pains in the left knee.

Examination revealed normal intelligence. Speech was slow with syllable stuttering. The patient walked with his right hand strongly grasping a cane. He inclined forward, trying to steady himself with his left hand, and when he descended stairs, the left leg was often violently thrust forward, remaining momentarily in the position of strong extension at the knee and flexion at the hip. At other times, the hip would be suddenly extended and the whole foot slapped to the ground. Occasionally the leg would become briskly flexed in all its joints, giving a typical steppage gait. When the patient was seated, inconstant brisk movements of flexion and extension of moderate excursion of the leg on the thigh and the feet on the leg were noticed.

Similar movements of adduction and abduction or of internal and external rotation of the various segments of the lower extremities were noticed, especially in the feet. Occasionally a moderate extension of the foot on the leg and of the leg on the thigh with flexion of the latter on the pelvis was noticed, this movement being bilateral and strong enough to hold the extremities at right angles to the pelvis; the position was held briefly, subsequent relaxation allowing the extremities to return to a normal position. Small movements of flexion and extension of the fingers, especially of the terminal phalanges, were noticed, particularly in the left hand; these movements were sometimes slow, and sometimes brisk. Sometimes small fibrillary, clonic movements or fascicular twitchings of irregular frequency and rhythm were noted, especially in the hypothenar eminence. Similar movements were noted in the calves and in the toes, especially the left. The movements of flexion and extension, adduction and abduction and rotation with the attitude of equinovarus were marked. Particularly strong irregular movements were noted in the bellies of the quadriceps, which would quickly be relaxed. This phenomenon was less marked in the right thigh. Occasional movements of similar character were noticed in the abdominal muscles, and also brisk contractions of the cremasterics or of the glutei and other pelvic muscles. Sometimes these constant involuntary movements began in waves with small localized twitchings in the left quadriceps, then larger stronger contractions of longer duration occurred. Finally the myoclonic jumps and waves of fascicular contractions or even fairly prolonged contraction of the entire quadriceps of the right side appeared; then brief, brisk contractions of one or the other thigh, and later a movement of relaxation and rest, with the quick resumption of the fibrillary and fascicular clonic movements. Occasionally there were interposed contractions of the glutei, rotators, and flexors of the pelvis, with strange contortions of the pelvis.

Neurologic examination also revealed the sluggish reactions of both pupils to light, the left pupil being larger. There was some weakness in the left hand, as shown by the dynamometer (the right hand registering 42 and the left 35). There were slight dysmetria and asynergia in the left upper extremity, and marked atrophy in the left lower extremity (2 cm.). There was hammer toe deformity of all toes of the left foot. There was some dysmetria in the left lower extremity, although it was difficult to examine this because of the rarely occurring quiet moment. The patient could not elevate either extended

lower extremity alone without immediately causing brisk movements of abduction and adduction, but both limbs together could be held elevated in extension. The patient was better on some days than others. Emotions and many stimuli made him worse. The involuntary movements disappeared in sleep but began a few minutes after he began to walk in the morning. There were no disturbances of sensation except a slight uncertainty about describing the position passively assumed by the various segments of the lower extremities. The roentgen ray showed a small liver shadow.

The laboratory examinations showed a negative Wassermann reaction in the blood and spinal fluid. The fluid was under normal pressure, and the Nonne-Apelt reaction was negative; there were three or four cells in each field (Ravaut).

Later the patient developed a marked lordosis and a marked steppage gait. Finally, bizarre attitudes of the entire trunk and extremities were assumed when walking. The speech became progressively more explosive and staccato. There seemed to be a brisk contraction of the muscles in inspiration thus causing the speech difficulty. The deep reflexes were always almost impossible to obtain, although it was definitely determined that they were present during his fleeting moments of rest. Those of the right side were slightly more active but the Achilles reflex was never obtainable. The author states that the patient had no paralysis following the onset with stupor in 1918.

Disregarding the fact that there is no evidence whatever that the patient fell or had any trauma, the author feels that the cause of his patient's trouble was precipitated by trauma acting in an old degenerated (alcoholic) abiotrophic nervous system. The tonic and clonic movements are explained by spinal, cortical or subcortical localization, while the disturbances of posture, astasia and the dysmetria incriminate the cerebellar system; the atrophy in the left leg is explained either by peripheral or central involvement. The author eliminates the possibility of a neuritis, and because it was impossible to obtain electrical reactions, he leaves the latter question unanswered.

In making a differential diagnosis, the author eliminates tabes, multiple sclerosis, the syndrome of Benedict, the paramyoclonus of Friedreich and Huntington's chorea. He considered chronic chorea and myoclonus epilepsy, and after comparing his case with the reported cases of dystonia muscularis deformans and Wilson's disease, he excluded both of these, and finally concluded that it was a case of dystonia lenticularis progressiva. The author feels that his case has many points of contact with Gowers' case as quoted by Wilson.

Considerable importance is attached to the fact that the patient showed traces of glycosuria (4 per cent.) for many days after the administration of 50 gm. of saccharose by mouth. This did not disappear until a carbohydrate restricted diet was given. In this connection is quoted the work of Roel and Lewy, who showed histologic alterations in the globus pallidus in four cases of diabetes. The fact that the roentgen ray showed a small liver shadow in the author's case is cited as an argument for placing the lesion in the lenticular nucleus.

While the author agrees that one should not attempt, as many have done, to place Wilson's disease, chorea, athetosis, paralysis agitans, Little's syndrome, tuberous sclerosis, etc., in the striatum, he feels that because of Hunt's work, his case probably belongs in the striatal group. He agrees with Hunt that the tremor, rigidity and dysarthria are part of a globus pallidus syndrome, while the putamen may have ascribed to it the involuntary tonic and clonic

contractions and the athetoses. This conception explains Wilson's disease, wherein there is degeneration of the entire lenticular nucleus. He recalls that Mingazzini localized the pathologic condition in cases showing monotremor of the forearm and hand in the medial portion of the putamen of the opposite side, the dysarthria being due to lesions of the putamen of the left side. In these cases, there is atrophy in the paretic extremities. In his case, the author feels that all of the symptoms, including the atrophy of the left leg and the epileptiform convulsions, can thus be explained. He finds difficulty in explaining the dysmetria and asynergia, except on the basis of the connections of the corpus striatum with the cerebellum, which he thinks are involved in his case.

OSNATO, New York.

SOME ENDOCRINE ASPECTS OF THE PSYCHE. (A LECTURE
DELIVERED TO THE UPSALA MEDICAL SOCIETY.) J. A.
HAMMAR, *Folia neuro-biolog.* 12:2, 1922.

Localization of different psychic processes depends to a great extent upon the structure and function of the nervous system. The author confines his article to the functional aspect of the question, and emphasizes the fact that the psychic processes are to some extent dependent on the reaction of the nerve elements to chemical influences.

Attention is called to the psychic alterations produced by the implantation of glands of the opposite sex in experimentally castrated animals, Steinach's case of the homosexual man in whom the testicle from a psychosexually normal person was implanted with successful results, is cited. The psychic changes occurring at puberty and the menopause, during pregnancy, and following castration, emphasize the rôle of the sex glands. The effects of thyroid feeding in cretinism, the mental reactions in exophthalmic goiter, sometimes a psychosis, and the syndromes found in acromegaly, Addison's disease and diabetes, furnish examples of the important influence which internal secretions have on nervous functions. Farrant's reports are reviewed, and the opinion is quoted that toxemia is the primary factor which influences mentality through the endocrine organs.

An elective hormonal action must be imagined which affects the elements of the nervous system in different ways in accordance with the varying type of hormonal secretion. It is probably a question of chemical affinity and chemical stimuli, of an electivity in the relations of nervous elements to chemical substances. The action on the nervous system of epinephrin, curarin, physostigmin, hypnotics and other substances, illustrates this electivity from the standpoint of pharmacology. Strychnin has an affinity for the motor parts of the brain; tuberculin, mallein, and diphtheria toxin become especially fixed to the lipoids, and tetanus toxin has an elective affinity for the albuminoids.

The activity of the endocrine substances in the system is directly analogous, but they are endogenous instead of exogenous. The cell is considered to be the point of election though the synapsis cannot be definitely ruled out. Sleep, as explained by Pitroy, depends on a "hypnotoxin" which is probably formed in the brain. Mention is also made of the theories about the function of glia cells, as to whether this is merely a supporting tissue or has a nutritive or trophic function.

The author considers that neurologic inferiority, either acquired or inherited, must rest on a chemical foundation. There is a wide range of individual susceptibility to certain poisonous substances such as alcohol, nicotine, caffeine,

etc., an idiosyncrasy which may be biochemical as well as biophysical in basis. The internal secretions, as chemical agents, markedly alter various somatic conditions, and produce changes in external appearance, as well as in psychic activity. Just how this takes place is, at present, mere speculation, because little is known of the functional interrelationship of the various glands.

The rôle of endocrine substances in emotional life has been investigated and it has been shown, for instance, that the thyroid and adrenals are largely concerned in the syndromes of anger and fear. Here the nervous system must be responsible for the glandular activity, but the manner of the innervation of the glands is based upon indirect observation. There has not been shown a double innervation—stimulatory and inhibitory—as in the case of the exocrine organs.

The central nervous system as the seat of origin of emotion is cited in contrast, and the statement is made that "the central excitation may be the primary factor and the endocrine mechanism may be stimulated through the autonomic nervous system." Cannon's experiments on the adrenals and thyroid, which test the reactivity through nervous stimulation, and the effect of the gland substances in the blood stream, are taken as authoritative.

Visceral alterations, either disease or malfunction, have a direct influence on psychic reactions and have been observed by every physician. But in them, there is the sensation produced by the organ disturbance, in addition to the psychic manifestations. In the endocrine organs no sensations of the structures themselves are ever manifest and the reaction is mainly psychic.

PATTEN, Philadelphia.

MENTAL HYGIENE NEEDS ARISING SUBSEQUENT TO SCHOOL LIFE. C. FLOYD HAVILAND, *Ment. Hyg.* 6:688 (Oct.) 1922.

This author gives first place in the mental-hygiene program to the period of childhood as the golden period for preventive work; yet he points out that until such preventive work shall have become far more effective than it is at present, the mental-hygiene needs of post-school life will constitute a vast social problem that must be met, for the sake of the community as well as for that of the persons concerned.

The extent of the problem is such that the state must necessarily play the chief rôle in dealing with it; and its most obvious duty in this respect is the provision of adequate facilities for the treatment of those mental patients who are legally termed insane. No state has yet been able to make such provision, owing to the increase in the number of known insane—an increase probably representing in part an actual increase in insanity, possibly due to economic depression, and in part an increased public confidence in state institutions. The net increase of patients on the books of the New York state hospitals for the fiscal year ending June 30, 1921 was 1,442, the greatest increase of any year in the history of the state hospital system. New York is endeavoring to meet this condition by a construction program that allows for a certain additional number of beds every year, and by a liberal use of the parole system; the number of patients on parole from the state's civil hospitals has increased by nearly 1,700 in the last five years. Besides the provision of a sufficient number of beds, the state should render the services of the state hospital readily available through laws permitting emergency commitment and voluntary admission under proper conditions.

While the state hospital should be essentially a curative institution, its functions include the partial rehabilitation of so-called chronic mental patients through

habit training and occupational therapy. This applies especially to patients suffering from dementia praecox, who may often be transformed from total liabilities to at least partial economic assets.

The extramural activities of the state hospital are no less important than the intramural. They include the placement and supervision of discharged and paroled patients, the treatment of incipient cases of mental disease in the community, and the dissemination of information on all matters pertaining to the maintenance of mental health. The outpatient mental clinic and its associated psychiatric social-work department are indispensable for this extramural work.

While the mental hospital should be prepared to treat all types of mental disease, there is a large field of usefulness in the immediate treatment of acute mental cases for the psychopathic hospital, conducted on the same basis as the general hospital, and for the psychopathic ward in the general hospital. This placing of mental disease on the same footing as other diseases will do more than anything else to change the old fatalistic attitude toward mental trouble.

In conclusion, the author emphasizes the fact that no public health movement is complete without a mental hygiene program; a human being is a psychobiologic unit in which psychic and physical elements are interdependent, and health implies harmonious adjustment, both physical and mental.

WILLIAMS, New York.

TWENTY CASES OF LETHARGIC ENCEPHALITIS WITH PATHOLOGICAL FINDINGS IN FOUR CASES. W. E. HUME, F. J. NATTRASS and A. F. B. SHAW, *Quart. J. Med.* 15:131 (Jan.) 1922.

This is a summary of twenty cases of lethargic encephalitis seen by the authors. There were fourteen males and six females; the ages varied from 6 to 60 years; the occupations were chiefly of artisan kind, one was a farmer; seventeen were urban residents and three rural; only one patient was known to have been in contact with other cases. In twelve cases the onset was acute, and in eight insidious. In five acute cases the initial rise of temperature was quickly followed by delirium. Three cases suffered with fever and neuritic pains. In the insidious cases the onset occurred with a gradually increasing drowsiness which continued for a few days to five weeks. Twelve patients suffered with diplopia, and six of these had a definite ocular palsy. In two cases there was bilateral ptosis. The pupillary reactions varied; three cases showed complete inactivity to light and accommodation; sluggish reactions were noted in five cases; in five the pupils were unequal but reacted to light and accommodation. In no case was there any evidence of optic neuritis even on repeated examinations. Nystagmus was present in two cases. Weakness of the muscles supplied by one seventh cranial nerve was noted in five cases. The majority of the cases showed restricted movements of the facial muscles ("Parkinsonian mask"). The right side of the tongue was paralyzed in one case. Fine tremors of muscle groups were present in four cases. Myoclonic movements were noted in fourteen cases (limbs nine, abdomen and back three, face and jaw two). Rigidity was present in five cases. The patella jerks were not obtained in one case; they were sluggish in one case, unequal in three cases, and exaggerated in one case. Three cases showed bilateral and three a unilateral Babinski sign. In one case there was complete retention of urine, in one case occasional retention and in three

cases temporary incontinence. The cerebrospinal fluid was examined in eight cases: one developed a coagulum; pleocytosis was present in four cases, an excess of sugar in two cases, and an excess of globulin in two cases. All Wassermann reactions were negative. Four deaths occurred on the fifteenth, twentieth, twenty-second, and thirtieth day of the disease. One case recovered in a week, one in six weeks, six in six to twelve weeks, and seven were convalescing for several months. Details are given of the history and symptoms of the four cases which resulted fatally together with a brief summary of the gross pathologic and histologic findings. None of these cases show anything hitherto undescribed.

In conclusion the authors state that a diagnosis of lethargic encephalitis must be reached by exclusion, but that a combination of any two or more of the following symptoms should suggest encephalitis lethargica: (1) fever at the onset of the illness; (2) an acute mental disturbance; (3) a gradually increasing lethargy; (4) a clinical picture of paralysis agitans; (5) myoclonic movements; (6) neuritic pains, which may alternate from side to side; (7) ocular palsies; (8) pupils which do not react to light.

POTTER, Mercer, Pa.

ENCEPHALITIS LETHARGICA. A. J. HALL, *Lancet* **202**:526 (March 18) 1922.

Hall reports thirty cases of lethargic encephalitis, and divides them into three groups: (1) Five mild or abortive cases of which only one, with myoclonic contractions of the abdominal muscles, is of interest. (2) Fourteen cases of medium severity. One was a boy of 12 years, who, on the nineteenth day of his illness, when convalescence had apparently been established, developed suddenly a series of left sided seizures, with loss of consciousness and a temperature of 105 F., after which he improved rapidly. In ten of these cases recovery was retarded or incomplete, and there developed mental deterioration, varying grades of Parkinsonian complex, or paraplegia. In one, of neuritic type, there was a complete flaccid paralysis of both legs, which began five weeks after the initial lethargy and cranial nerve palsies, and disappeared some eight months later. (3) Eleven fatal cases. In commenting on the after history of sixteen previously reported cases, the author calls attention to two patients who had suffered with a polyneuritic syndrome. One made a complete recovery and the other was still unable to walk after three years. In conclusion Hall remarks that it is often impossible during the progress of a case to form an opinion as to the prospect for recovery.

POTTER, Mercer, Pa.

PATHOLOGICAL FINDINGS IN A CASE OF CHRONIC PROGRESSIVE ENCEPHALITIS. M. G. MARINESCO, *Rev. Neurol.* **29**:1012-1019 (July) 1922.

Marinesco reports in detail the necropsy findings in a case of progressive Parkinson syndrome, in which death occurred two years after the onset of epidemic encephalitis. In this case there had been no interval, after the acute stage, in which there was freedom from symptoms.

The pituitary body was found to be normal. In the suprarenals there was infiltration with plasma cells and lymphocytes around the blood vessels. In the suprarenal medulla, which was involved more than the cortex, the chromatin cells showed alterations. In the parotid gland there were marked inflamma-

tory changes which indicated that infection was still active. Marinesco refers to Netter who has frequently found a similar condition in the parotid, and is inclined to believe that it may serve as a focus for the continued production of toxins.

In the central nervous system, the cortex, corpus Luys, the red nucleus and the nucleus of the hypoglossal nerve showed only slight alterations. In the putamen there were vascular lesions and disintegration of the myelin. In the globus pallidus the cells showed two types of change: (1) a lesion which included both degeneration and atrophy; and (2) one in which the volume of the cells was normal but there was dissolution of the chromatin substance, with pale staining of the nucleus and vacuolization. In the substantia nigra there were marked alterations. The pigmentary cells especially had undergone cytolysis, the nerve fibers were much decreased, and there was plasma cell infiltration and neuroglial proliferation about the blood vessels and throughout the white and gray matter. The floor of the fourth ventricle showed an infiltration as marked as that in the substantia nigra. In the muscles, the nerve fibers showed degeneration and the connective tissue enveloping them had increased.

Marinesco suggests that the muscular changes are secondary to mesencephalic lesions which, by producing functional disturbance in the cerebral ends of the autonomic system, cause faulty metabolism in muscular tissue. This is evidenced not only by the anatomic changes but also by electrical variations in muscle response and in reduced temperature in muscle tissue. Marinesco accounts for the marked degeneration and atrophy of cells in the substantia nigra by an especially poor resistance to cytolytic toxins. He disagrees with Hunt as to the part played by the globus pallidus in paralysis agitans, but does agree that both the globus pallidus and the substantia nigra play an essential rôle in the symptomatology of paralysis agitans and post-encephalitic Parkinson syndromes.

HYSLOP, New York.

**ATROPHY OF THE CEREBELLUM IN ADULTS WITH THE REPORT
OF A CLINICAL CASE. ARRIGO FRIGERIO, Riv. di Patol. Nerv. e Ment.
27:457 (Oct. 15) 1922.**

The author's patient, a woman of unknown age, was admitted to the hospital on Feb. 26, 1920. Her age appeared to be about 65 or 70. About seventeen years before, she began to have difficulty in walking, which she attributed to the fact that she had to carry heavy weights on her head. Gradually the gait became rolling and unsteady, and occasionally she fell backward. In the next few years the disturbance of gait became so severe that she spent much time in various hospitals. Finally, she was committed by the police, because she went about ringing bells, refused food, and had other mental symptoms.

When examined her speech was slow, scanning and explosive. She omitted the final vowels in words and gave to the dentals the sound of palatals. There was a lateral tremor of the head when it was held upright, which disappeared when she rested in bed. The left pupil was larger than the right, but the reactions were normal. There was horizontal nystagmus in the extreme lateral positions, especially on fixation to the right; on looking upward and downward the nystagmus was rotary. The fundi were normal. When the arms were extended, there were massive oscillations which were not seen when the patient was at rest. The finger to nose test showed dysmetria with oscillations at the end of the movement. All movements were awkward. When the

patient grasped a glass, there was exaggerated opening of the hand. There was *adiadokokinesia*, especially in the left. There was hypotonia in all joints of the left upper extremity, but the Stewart-Holmes phenomenon was inconclusive. The heel to knee, and toe to elevated object, tests showed marked oscillations but the movements ceased when completed. The patient remained supine with legs and thighs flexed until the observer was fatigued; the author calls this cerebellar catalepsy. The patient often assumed a catatonic attitude, with the head flexed and the chin on the chest, for long periods without fatigue or effort. Extension of the limbs tended to be performed in two motions. Closing the eyes had no effect on the dysmetria. There were no disturbances of sensibility. The deep reflexes were all increased and there was a tendency to patellar clonus. The corneal reflexes were unequally active and the abdominal reflexes were absent. When the patient sat, there was lateral swaying of the trunk and a tendency to slump backward. When standing, the feet were unduly spread, the arms akimbo and the head bent forward. This attitude was accentuated by the kyphosis which was present. If she was not held on both sides, she would immediately fall backwards. However, she could walk forward with assistance on each side or with crutches. The crutches were held unduly separated and it might almost be said that she walked on four extremities. When she walked, the limbs were hyperflexed and the feet were slapped violently to the ground, or the legs were thrust out violently or crossed. The steps were of unequal, irregular length and progression, with lateral titubation. The Bárány and cochlear investigations were negative. There was no vertigo, headache, nor vomiting during the month in the hospital. Mentally, the patient showed mild intellectual dulness with a tendency toward irritability, but she was fairly docile.

The diagnosis made by the author was cerebellar atrophy. He discusses the various types of this condition and uses the classification of Dejerine: (1) Partial or asymmetrical: (a) secondary to foci of softening, and possibly of hemorrhage, but usually follows sclerosis of the cerebellar hemispheres; (b) congenital types. (2) Generalized symmetrical atrophies of: (a) the sclerotic type, secondary to inflammatory vascular reactions; (b) agenetic type; (c) the parenchymatous, degenerative type involving the cells of Purkinje and their fibers. (3) Another type is described by Dejerine and Thomas wherein the cerebellar cortical lesions are associated with degenerations in the pons and the olivary bodies. In some of these cases described by other authors, there were diffuse degenerative changes in the striatum or the frontal lobes, or in the bulb and rubrocerebellar or olivocerebellar connections.

Reference is also made to the *dyssynergia progressiva cerebellaris* of Ramsey Hunt. The author believes that his case belongs to the third sub-group of Dejerine. On the basis of his clinical findings, he speculates on the possible pathology. He eliminates the various pathologic types, and compares his case with that described by Ramsey Hunt.

OSNATO, New York.

THE IMPORTANCE OF A SPECIAL EDUCATIONAL TRAINING FOR
MENTAL DEFECT DEPENDENT UPON ORGANIC LESIONS.
L. PIERCE CLARK, *Ment. Hyg.* 6:708 (Oct.) 1922.

This article urges the importance of differentiating in the matter of treatment between cases of mental defect due to organic lesion and the so-called genetic or hereditary types, since in the former the undamaged portions of the brain are capable of benefit by the same kind of training as the normal brain.

To illustrate, Clark cites three cases in which the mere designation of mental defect was not specific enough to serve as a basis for training and would have resulted in lasting detriment to the child if followed to a final disposal of the case. The first is that of a 6-year old girl suffering from cerebrocerebellar diplegia. She was speechless and had the repellent leer of a low-grade mental defective. Tests showed that the greater part of her apparent mental deficiency was overlaid by the motor defects. Instead of being sent to a school for defectives, she was placed with private tutors, under a system of training especially adapted to overcome her handicaps; with the result that at the age of 12 she has begun to attend common school, is nearly up to grade in classwork, and shows an almost uncanny genius for mechanical work.

In the second case, also that of a girl suffering from cerebrocerebellar diplegia, mentality was retarded four or five years, apparently largely as a result of definite nerve lesion. The child was placed in a school for defectives, but did poorly under the routine training given there, and finally was removed and placed with special tutors and with normal associates. Under this treatment her mental progress has doubled.

The third case is that of a boy who, when first seen at the age of 3, was a low-grade idiot. His mental state was apparently secondary to a meningitis, which in turn was secondary to a double pneumonia from a severe chronic colitis at the age of 18 months. He was placed in one of the best schools for defective children for two years; he made some improvement in conduct, but little mental advance. He could not express a want, knew nothing at all about dressing himself, and spent his time roaming about aimlessly. For the last two years he has been under private tutors and has made remarkable strides in mental development. His physical condition was first attended to, as he was suffering from a severe colitis. Mental and speech training were then begun and patiently continued, in spite of the difficulty of holding his attention for more than a few seconds at a time. At present he can make up short sentences, can understand any request, and displays a rather remarkable memory as to where various articles are kept. He knows all the articles of his clothing, and but for a slight deformity in the index finger of each hand which prevents his using them in buttoning, is able to dress and undress himself. He is healthy and happy, and shows more ability to create his own amusements.

In cases of mental defect accompanied by organic lesion, care must be taken to apportion to each factor its proper rôle in the hindrance of development. For children whose inheritance is much tainted, the possibilities of development are poor even when the brain is only slightly damaged; on the other hand, surprising improvements may be expected in children of untainted parentage suffering from brain injury incurred at birth or early in life, with the exception of hemiplegic patients with or without epilepsy; in this respect a double palsy is much more hopeful than a strictly unilateral palsy.

The training treatment for children with acquired mental defect should be directed partly toward overcoming the structural defects in the brain, but should consist principally in a modification of the usual common school methods. Clark emphasizes the importance of association with normal children on terms as nearly normal as possible. For the child suffering from hereditary mental defect, on the contrary, segregation should be sought for the best interests both of the child and of society.

WILLIAMS, New York.

THE PSYCHIATRIC INSTITUTE-HOSPITAL. LEWIS F. PILCHER, State Hosp. Quart. 8:3 (Nov.) 1922.

The author reviews the reasons for the need of a psychiatric hospital and institute that should have facilities for the treatment of early mental disorders and for medical education and research. He reports the recommendation of the New York State Hospital Development Commission, which resulted in definite legislation and the appropriation of money for this purpose. This psychiatric institute-hospital requires six major departments: (1) administration, (2) outpatient clinic, (3) diagnostic clinic, (4) research and teaching, (5) hospital providing 180 beds for adults and 20 beds for children, and (6) residence for personnel.

The building plan, in order to house these departments, should follow the "H" shape plan, including: (a) the clinic institute wing, (b) the hospital wing, and (c) the laboratory wing connecting (a) and (b).

The administration department, including all offices, should be centrally located on the first floor in the institute wing.

Several entrances to the outpatient clinic are advisable so that quiet patients, disturbed patients and children may be admitted separately. The need for a large and adequately lighted waiting room and several examining rooms is discussed, as well as the value of the appointment system in facilitating prompt examinations and avoiding overcrowding. Separate rooms for roentgen ray, gastro-intestinal, eye, ear, nose and throat, endocrinology, spinal fluid, Wassermann, dental and psychologic examinations should be in close proximity to the clinic.

The diagnostic clinic should be arranged so that the laboratory, examination and treatment rooms are available for both the hospital and outpatient clinics. The necessities for hydrotherapeutic, electrotherapeutic and mechanotherapeutic work are also located on the first floor.

On the second floor, the laboratory rooms necessary for the research work are placed in the arm connecting the institute and hospital portions. These laboratories include the psychologic, clinical, bacteriologic, chemical and neuropathologic group. The author includes in his plan a large lecture room seating 150 people. This room and rooms for a library and museum are placed on the second floor in the institute wing.

On the second, third and fourth floors of the hospital wing, arrangements are made for six classification dormitories. Day rooms opening on porches are also planned. Adequate provision is made on the entire fourth floor for visiting psychiatrists from the various state hospitals and for the hospital personnel.

The fifth floor of the hospital wing contains the major and minor surgical units and space for work in photography and for a gymnasium with its accessories.

EBAUGH, Philadelphia.

A STUDY IN CONSTITUTIONAL PSYCHOPATHIC INFERIORITY. JOHN W. VISHER, Ment. Hyg. 6:729 (Oct.) 1922.

Visher points out the inadequacy of the older definitions and proposes the following description: "From the psychological standpoint, the constitutional psychopathic inferior presents marked inherent defects in volition and inhibition, together with lowered threshold for and a disproportionate response to implicit and explicit stimuli. There is also a lack of balance in the various hereditary and acquired reaction patterns and habit systems. The individual is unable

to adjust to his inadequacies, either by means of experience or by the formation of compensatory modes of reaction. From the behavioristic standpoint, the condition is characterized by marked egotism, impulsiveness, poor judgment, non-conformity to ethical and social standards, and inability to adjust or to profit by discipline."

A statistical study of fifty psychopathic soldiers before, during and after hospitalization, produced some interesting information. Twenty had a neurotic family history, twenty-eight reached the eighth grade or higher, twenty-five had poor industrial records, twenty-six admitted having been arrested in civil life, six were morphin addicts, two were alcoholic, and five used other drugs to excess. Of seventeen who were married, all but five had had serious marital difficulties. Judged by ordinary standards only three of the entire fifty had somatic conditions of sufficient importance to warrant hospital care. The after work record shows that thirty-two of the patients were employed less than 10 per cent. of the total time since discharge from the hospital.

The author concludes that "military service greatly decreased industrial efficiency and led to prolonged hospitalization" and that "treatment of the adult psychopath by psychotherapy, re-education and hospitalization is of but little avail. Vocational guidance is theoretically indicated, but practically is usually unsuccessful.

STRECKER, Philadelphia.

PSYCHOLOGY IN MEDICINE. F. L. WELLS, *Ment. Hyg.* 6:700 (Oct.) 1922.

Wells attributes the present ambiguous relations between psychology and medicine to medieval dualism, which resulted in their development as two unrelated fields. It is only recently that psychology has become one of the biologic sciences, as the science that has to do with the processes by which the organism reacts as a whole to the environment and to its own conditions, and hence, in one of its aspects, the science of behavior. And it is only recently that medicine has turned from its exclusive preoccupation with bodily processes and begun to assume responsibility for the behavior of the organism as a whole. Meeting thus in the field of human conduct, medicine and psychology have not as yet joined forces, with the unfortunate result that psychologists inadequately equipped with medical knowledge are called on to deal with medical problems, while medical men with little grounding in psychology are confronted with psychologic problems. Two solutions are possible: medicine and psychology can enter into the same cooperative relationship as that now existing between medicine and chemistry, or psychology can develop a new discipline that will to a certain extent compensate for lack of medical affiliations. Wells feels that the former course will better serve the interests of the two sciences as well as of society.

With regard to psychoanalysis, while granting that creditable work has been done by nonmedical psychologists, he inclines to the opinion that psychoanalytic material belongs to the field of medicine rather than that of psychology, and that the practice of psychoanalysis involves risks to both operator and subject that should be reluctantly undertaken outside the setting of responsibility that medicine traditionally provides.

Again, in the matter of the exercise by psychologists of public functions, especially the commitment of feeble-minded persons, he feels that the responsibility should not be assumed by a nonmedical person, since every case of mental defect is potentially a medical problem. On the other hand, the type of experience embodied in the American Psychological Association's Section of

Clinical Psychology should be represented in such cases, and the committing physician has not always had the opportunity to acquire such experience. For states such as New York, where this type of expert experience is readily available, Wells suggests a law to the effect that one of the committing officers shall have had training of this type.

The protection of the public from inadequately trained psychologists must, he feels, ultimately rest with the public itself; but scientific psychology may properly be asked to formulate adequate standards and to make service governed by such standards reasonably available. The regulation of consulting psychologists by the general association, and the Psychological Corporation, are moves in this direction.

WILLIAMS, New York.

SOME OBSERVATIONS ON QUALITATIVE CHEMICAL AND PHYSICAL STIMULATIONS IN NUDIBRANCHIATE MOLLUSKS WITH SPECIAL REFERENCE TO THE ROLE OF THE "RHINOPHORES."
H. P. KJERSCHOW AGERSBORG, Jour. Exper. Zool. **36**:423 (Nov.) 1922.

An investigation was made to determine the exact function of the dorsal tentacles of three species of mollusks. These tentacles have come to be considered as organs of smell, and are generally called "rhinophoria." *Hermisenda opalescens* Cooper responds to tactile stimuli applied to any part of the body: the heads, the oral and dorsal tentacles, the body, the various parts of the foot, and the papillae. The dorsal tentacles give the most effective response to a tactile stimulus, such as the end of a glass rod. The head and the dorsal tentacles are most sensitive to acids and salts in solution. The tentacles are more sensitive, the tips giving the most effective response. The oral tentacles are almost as sensitive to stimuli as are the dorsal tentacles, but in addition to a general response of this nature, the oral tentacles also have a selective function in that when they are stimulated by some palatable food, the animal may be made to move in the direction of the stimulus; if the animal responds to a stimulus negatively, the appliance of it in front of a progressively moving animal may bring it to a halt; the directions of its movements may also be changed. The oral tentacles have the power of discrimination between certain substances, such as food and odorous oils, while the dorsal tentacles lack this power for the same substances. There is no evidence that the "rhinophores" are olfactory in function.

The dorsal tentacles of *Dendronotus giganteus*, like those of *Hermisenda*, are the most sensitive parts of the body to tactile stimuli. In *Melibe leonina* Gould the cirrhi are more sensitive to tactile stimuli than are the dorsal tentacles.

WYMAN, Boston.

ON THE OCCURRENCE OF REFLEX ARCS IN THE MYENTERIC AND SUBMUCOUS PLEXUSES. ALBERT KUNTZ, Anat. Rec. **24**:193, 1922.

Synaptic relationships are described which involve an axon in a commissure which connects the submucous with the myenteric plexus and a neuron located in a ganglion in the latter plexus. The synapses involve two neurons and constitute a nervous mechanism within the walls of the stomach and intestine through which local reflexes may be carried out. Fibers which arise primarily in the submucous plexus terminate in the muscularis mucosae among the glands in the mucosa, and also in the gastric and intestinal epithelium. The fibers which terminate in the epithelium are probably the dendrons of

neurons in the submucous plexus. The findings afford a structural basis for the rational interpretation of all the usual activities of the stomach and intestine except the rhythmic contractions which, according to the work of Magnus, Gunn and Underhill, and Alvarez and Mahoney, are of a myogenic nature.

NIXON, San Francisco.

THE NEED OF PSYCHOPATHIC DEPARTMENTS IN STATE HOSPITALS. JOHN R. ROSS, *State Hosp. Quart.* 8:34 (Nov.) 1922.

Psychopathic hospitals have an important place in the prevention and cure of mental diseases. Ross states that the establishment of psychopathic departments in state hospitals will play an important part in the care of early mental disorders, when the patient is most susceptible to remedial treatment. These psychopathic units should be known throughout the district as places where advice and treatment can be obtained without judicial commitment to a hospital for the insane. The author rightly feels that with such a unit properly manned, treatment of patients would improve and real curative measures be introduced. The article is concluded with a discussion concerning building plans, arrangements for classification of patients, personnel, nursing care, laboratory facilities and occupational therapy. The need of the outpatient clinic and the part such a unit should play in public education regarding mental diseases, is emphasized.

EBAUGH, Philadelphia.

ALCOHOLIC PSYCHOSES BEFORE AND AFTER PROHIBITION. HORATIO M. POLLOCK, *Ment. Hyg.* 6:815 (Oct.) 1922.

Pollock uses the term alcoholic psychosis as defined in the federal census report on the insane in hospitals in 1910: An alcoholic psychosis is one of the mental diseases that are known by their characteristic symptoms to be the direct result of alcoholic intemperance; cases of mental disease in which alcoholic intemperance is only one of the etiologic factors and cases merely associated with alcoholic intemperance should not be classed as alcoholic psychoses.

Using the 1910 census as a basis for comparison, the present study gives the results of various compilations of data on alcoholic psychoses since that census was taken. These data show that there has been a marked reduction in the prevalence of alcoholic psychoses throughout the United States since 1910—a reduction due partly, Pollock believes, to restrictions on the liquor traffic and partly to changes in the habits of the people. Of 60,769 patients with mental disease admitted to institutions in 1910, 10.1 per cent. were reported as cases of alcoholic psychosis, while the annual rate of admission of alcoholic cases was 6.7 per 100,000 of general population. The latest available data concerning the prevalence of alcoholic psychoses throughout the country were compiled by the statistical department of the National Committee for Mental Hygiene from original standardized reports of state hospitals. Based on the statistics from the hospitals of fourteen states, the percentage of alcoholic admissions to all admissions in the year 1921 was 3.1 and the rate of incidence in the general population 1.9, a noticeable decline from the census rates.

A corresponding decline appears in the figures for the New York state hospitals in the years 1909-1921, as compiled by the statistical bureau of the New York State Hospital Commission. In 1909, the percentage of alcoholic first admissions to all first admissions was 10.8, and the rate of incidence in the

general population was 6.3; in 1921, these rates were 2.8 and 1.8, respectively. At the same time, there has been a decline in the number of cases among all first admissions in which there is a record of intemperate use of alcohol; in 1909, such cases constituted 28.7 of all first admissions, while in 1921, this rate had declined to 11.8. Data from the official records of Massachusetts tell the same story: in 1912, the percentage of alcoholic first admissions to the state hospitals for mental disease and McLean Hospital was 11.3; in 1921, it was 4.9.

In all these compilations, the lowest rates appear in the year 1920. The slight increase in 1921, Pollock attributes partly to lax administration of the liquor laws, partly to economic depression.

That the rate of first admissions with alcoholic psychoses is closely correlated with the per capita consumption of liquors is evident from a comparison of the index numbers of rates of alcoholic first admissions to New York state hospitals with the index numbers of per capita consumption of liquors in the United States for the twelve years from 1909 to 1920. The coefficient of correlation between the two series is 0.875 ± 0.045 . Pollock is of the opinion that an even closer correlation would have been found had the data relative to the per capita consumption of liquors in New York state been available.

Comparative statistics from twenty states with regard to the sex distribution of alcoholic first admissions for the years from 1919 to 1921 show that the rate of decline under prohibition has been relatively greater among women than among men. The suggested explanation is that women are less likely than men to come in contact with the bootlegger.

During the whole period for which adequate data are available, alcoholic psychoses have been much more prevalent in urban than in rural districts. In 1910, the rate of alcoholic admissions in the United States was 10.7 per 100,000 in the urban population and 2.6 in the rural, and the admissions from urban districts constituted 77.8 per cent. of all the alcoholic admissions. This percentage has increased since. A study of first admissions to the New York civil state hospitals from July 1, 1915, to June 30, 1920, showed that 90.9 per cent. of the alcoholic first admissions were from urban districts. These figures are borne out by representative data compiled by the statistical department of the National Committee for Mental Hygiene from the state hospital reports of several states in 1919, 1920 and 1921. In these years, the percentages of alcoholic first admissions from urban districts were 85.6, 83.9 and 84.4, respectively, while the percentages from rural districts were 14.4, 16.1 and 15.6.

WILLIAMS, New York.

A QUANTITATIVE STUDY OF TARSAL SENSITIVITY TO SOLUTIONS OF SACCHAROSE, IN THE RED ADMIRAL BUTTERFLY, *PYRAMEIS ATALANTA* LINN. DWIGHT E. MINNICH, Jour. Exper. Zool. **36**: 445 (Nov.) 1922.

Many insects are extremely sensitive to distant chemical stimulation. The nymphalid butterflies, *Vanessa antiopa* and *Pyrameis atalanta*, possess taste organs or contact chemoreceptors on their ambulatory tarsi. Distilled water and solutions of several substances, including molar saccharose, can be differentiated through the tarsal organs. Contact of the four ambulatory tarsi with molar saccharose solution will always effect an extension of the proboscis, and so will contact with distilled water after a prolonged period of inanition with respect to water. The latter response ceases if the animal is allowed to drink water. By administration of water, *Pyrameis* can be maintained in a state of 0 per cent. responsiveness to water, but of 100 per cent. responsiveness to molar

saccharose. The minimal concentration of saccharose necessary to effect a response can be determined. In *Pyrameis* the threshold of response to saccharose solutions varies directly with the nutritional condition of the individual. During periods of total inanition followed by periods of water diet, that is, during saccharose inanition, it gradually falls. But with the initiation of a period of saccharose diet, it rises abruptly to a level which remains constant throughout the remainder of the period. After prolonged inanition with respect to saccharose the threshold concentration may fall as low as M/3,200, M/6,400, or even M/12,800 in some individuals. The tarsal sensitivity of *Pyrameis* to saccharose may thus be as much as 256 times that of the human tongue. The highly developed sensitivity to saccharose is doubtless correlated with the fact that sugars form the chief food of this insect.

WYMAN, Boston.

THE GENETIC ORIGIN OF DEMENTIA PRAECOX. FREDERICK W. MOTT, J. Ment. Sc. 68:333 (Oct.) 1922.

Mott's conception of dementia praecox is rigidly organic, and he has ingeniously linked his original studies of testicular degeneration in this disease with a fairly well supported premise of the inadequacy of more recently acquired brain structure. The neocortex consists of six cellular layers: one molecular, three pyramidal, one granular and one polymorphous. The psychomotor cells of earlier ontogenesis may be regarded as belonging to a lower evolutionary level, and their axonic myelization is older than that of other neurons. The supragranular layer is a later acquisition than the infragranular, both phylogenetically and ontogenetically. The former is associated with educability as contrasted with the reproductive and vegetative functions of the latter. The neocortex as a whole represents the final, highest and most complexly differentiated evolutionary structure, and as such is peculiar to homo sapiens. Following the biologic dictum of Hughlings Jackson "The last cerebral structures to come evolutionally and developmentally are the first to go," Mott suggests that dementia praecox, or primary dementia as he prefers to call it, may be referred to a genetic inadequacy which is partially manifest in the reproductive organs at adolescence, and which reveals itself clinically through an arrest of neocortical growth. Physical, physiologic or psychologic stresses or strains may act as precipitating agents.

"I am of the opinion that all the psychoses belong to one group and are genetic in origin. In those forms of psychoses in which recovery takes place—for example, confusional insanity or exhaustion psychosis, benign stupor, periodic insanity, or manic-depressive insanity—we may assume there is a suspension of neuronic function in the highest psychic level; but all these conditions I have found may end in terminal dementia, in which the changes in the reproductive organs and in the brain do not differ from those met with in the primary dementia of adolescence, the dementia indicative of a suppression of function. In the primary dementias, naturally, the symptoms may be partially due to a suspension, and partially to a suppression of function, and I would explain partial remission of symptoms by a partial restoration of function in neurones in which the nuclear change was either not present or not advanced."

The foregoing statements are interesting, but somewhat startling. For the present, they must be dismissed with the old Scotch verdict "not proven," with the sincere hope that Mott and his co-workers will continue their investigations.

STRECKER, Philadelphia.

BODY AND MIND: THE ORIGIN OF DUALISM. FREDERICK MOTT, *Ment. Hyg.* 6:673 (Oct.) 1922.

Mott reviews briefly the various stages in the history of philosophical and scientific thought that led from the primitive conception of the body and the soul as separate entities—a conception centering largely around the idea of death—to the modern view of the inseparability of mental and physiologic processes.

From the standpoint of biologic psychology, the sources of mental activity in man and animal are the three primal instincts: self-preservation, propagation and the herd. The physiologic bases of these instincts are specific biorhythms that in the course of ages have become fixed and organized in the bodily structures, especially the nervous system, in response to particular stimuli that subserve these instincts. Associated with the primal instincts are certain states of feeling and bodily reactions that constitute the primitive emotions. These instinctive reactions can take place independently of consciousness; Mott cites cases of decerebrate dogs that manifested anger and disgust. The intimate relationship between these instincts and emotions and the structures of the body is evidenced by the profound influence of the glands of internal secretion, especially the sex glands, on mental life.

Any experience attended by deep feeling and emotional discharge sets up in the unconscious sensorimotor and vegetative systems the physicochemical changes that constitute the biorhythm attuned to the particular emotion involved. Long after an experience with an intense emotional tone has left the field of consciousness, it may still be operating subconsciously, the involuntary and unconscious bodily expression of the emotion exciting the associated subconscious memory of the experience and this in turn reacting on the body.

The vicious circle thus established explains (1) the perseveration of hysterical derangements of mind and body resulting from emotional shock, and (2) anxiety neuroses involving a conflict between the instinct of self-preservation and the herd instinct. In the late war, cases of the former were cured by breaking the vicious circle through cure of the bodily symptoms by various methods of contrasuggestion or persuasion; a complete change of mental attitude followed bodily recovery.

In the anxiety neuroses, the form of nervous disability most common among officers, the instinct of self-preservation played a less dominant rôle than among the rank and file, the anxiety neurosis having its origin in fear of losing the esteem of the herd. The fact that the mental and physical effects were frequently similar to those produced by fear for self-preservation may be explained on the ground that the two instincts have been attuned by evolution to a corresponding biorhythm in respect to fear.

The article closes with a short description of Hughlings Jackson's three evolutionary levels.

WILLIAMS, New York.

MIXED CELL SARCOMA OF THE BRAIN. LEO M. CRAFTS, *J. A. M. A.* 79:1910 (Dec. 2) 1922.

At the age of 22, the patient was struck on the forehead by a plank. Following this he suffered from headache, and later mental changes were noted. A diagnosis of brain tumor in the right frontal region was made, and three operations were performed at intervals of two months. At the second and third operation a tumor mass or masses were removed from the right frontal lobe. By reference to the roentgenograms and skull measurements, it appears that

one tumor passed through 1 inch (2.54 cm.) and the other through 2 inches (5.08 cm.) of brain substance spontaneously to reach the surface. After two years, there was no indication of further recurrence. Another interesting feature of this case was the presence of well marked speech disturbances in a right-sided lesion; the patient began to write with the left hand, but was trained to use the right.

NIXON, San Francisco.

SOME VARIETIES OF TRAUMATIC AND TOXIC ULNAR NEURITIS.

E. F. BUZZARD, *Lancet* **202**:317 (Feb. 18) 1922.

In this paper the author invites attention to neuritis with no obvious anatomic features, cases with additional toxic factors and those with some anatomic peculiarities. Numerous cases illustrating each group are cited briefly. In the first group, excessive or prolonged use of the arm or hand in a fixed position is considered as the chief exciting cause. In the second group some infective or septic illness is held to be an added factor. In the third group Buzzard places those cases with a history of a severe injury to the elbow at some time, as well as cases without the history of such trauma but with some deviation from the normal anatomic relations. In this last group he describes several cases in which the ulnar groove was shallow and permitted the nerve to slip over the inner condyle, and thus to be exposed to more or less continuous slight injuries, which resulted in the formation of a fusiform neuroma with constricting fibrous bands. In such cases he advocates the transposition of the nerve to the front of the elbow and the removal of the constricting bands. This author believes that a careful examination should suffice to distinguish ulnar palsy from spinal cord disease or from cervical ribs resulting in plexus lesions.

POTTER, Mercer, Pa.

ON THE AFFERENT PATHS OF THE SYMPATHETIC NERVOUS SYSTEM, WITH SPECIAL REFERENCE TO NERVE CELLS OF SPINAL GANGLIA SENDING THEIR PERIPHERAL PROCESSES INTO THE RAMI COMMUNICANTES. OTTORINO ROSSI, *Jour. Comp. Neurol.* **34**:493, 1922.

Since Kölliker's anatomic demonstration in 1894 of fibers passing from spinal ganglions into the sympathetic nervous system through rami communicantes, there has been accumulating a large amount of evidence that these fibers form the chief (if not the only) pathway for sensory nervous impulses from the sympathetic to the cerebrospinal nervous system. But no one has hitherto pictured the actual connection of these fibers with cells of the spinal ganglions. This Rossi has accomplished in Golgi preparations of the bird (sparrow) and mammal (pig). These neurons are regarded as afferent visceral sensory elements.

C. J. HERRICK, Chicago.

MUTUAL RELATIONSHIP IN THE DEVELOPMENT OF THE BRAIN AND EYES OF LEPIDOPTERA. STEFEN KOPÉČ, *Jour. Exper. Zool.* **36**:459 (Nov.) 1922.

The whole brain (ganglion supra-oesophageale) was removed from caterpillars of *Lymantria dispar* L after their last moult, and the caterpillars were allowed to develop into adults. The larval optic ganglions were also removed in some. The eyes of the moths developed in complete independence of the brain,

and the subesophageal ganglion. The brain exerts only a regulating influence on the direction of the nerve fibers going from the retina of the eye to the optic ganglion. On the other hand, if the imaginal eye, the germ of which had been removed in the caterpillar, is absent, the external layers of the optic ganglion do not develop, and certain internal layers show changes in their structure. The germs of mature eyes grafted from the head of the caterpillar on its abdomen develop normally, notwithstanding the absence of any junction with the nervous chain. In specimens deprived of brain the subesophageal ganglion develops to a markedly less degree than in normal specimens. The removal of the larval subesophageal ganglion has no visible effect on the formation of the imaginal brain.

WYMAN, Boston.

NEUROPATHIC ARTHRITIS. JOHN H. DUNCAN, J. A. M. A. 79:1987 (Dec. 9) 1922.

The case reported represents what happens to a joint when afferent nerves are destroyed. The patient received an injury to the right shoulder, in which the posterior roots of the lower cervical and upper thoracic roots were divided or torn out. There was complete disorganization of the carpus, and it was impossible to recognize all the carpal bones. The distal ends of the radius and ulna were hypertrophied, and the periosteum of each showed bone formation. From the clinical and roentgenographic appearance of the joint, the increased density with the absence of pain, the associated area of anesthesia and the history of injury, the author concluded that the condition was a neuropathic arthritis.

NIXON, San Francisco.

HYSTERIA. A. BALDIE, Dublin J. M. Sc. 4:529 (Dec.) 1921.

Baldie defines hysteria as "state of mind depending upon a restriction of sentiments and emotions, resulting in a moral perversion of the individual, due to a failure of adaptation to environment, characterized objectively by the occurrence, as rationalizations, of phenomena which are defensive or protective in origin." This author believes that a diagnosis of hysteria depends primarily on the presence of the philomorbic syndrome: a defect in character evidenced by the restriction of the sentiments, an antipathy to activity, and a disordered suggestibility based on this. An organic basis, for the protean objective phenomena encountered, must be excluded. In considering the differential diagnosis, Baldie calls attention to the importance of distinguishing between neurasthenia and hysteria. He states that neurasthenia is a condition which is due to an intense or prolonged psychologic conflict, while the hysterical person represents the type of psychoneurotic who has solved his conflict in the wrong way. Another source of error, in making a diagnosis of hysteria, is the presence of an incipient organic nervous disease. Given the necessary environment for a cure, the prognosis in hysteria is good. The stimulation of inhibited or absent sentiments or desires and their conversion into habits of mental activity is essential. Voluntary congenial and profitable work is also necessary.

POTTER, Mercer, Pa.

BRACHIAL MONOPLÉGIA DUE TO THROMBOSIS OF THE SUBCLAVIAN VEIN. GEORGE WILSON, Am. J. M. Sc. 163:899 (June) 1922.

A survey of the literature shows the relative rarity of subclavian thrombosis. Wilson points out that in none of the cases cited was a brachial

monoplegia secondary to the phlebitis. The two cases presented by the author occurred in young negroes. Both gave a history of sudden onset. They awoke to find the hand and arm tense and swollen, and the edema persisted for some time. A complete monoplegia was at once apparent, but gradually disappeared as the swelling of the arm subsided. In one case, however, return of function occurred only above the elbow, the muscles of the forearm showing atrophy and degeneration. The other monoplegia improved steadily, due perhaps to the multiple incisions made in the skin to reduce the edema at the time of the thrombosis.

Syphilis is generally considered to be the etiological factor, though one case has been reported during typhoid fever. One of the author's cases was definitely syphilitic, the other presented a clinical picture of tuberculosis, which was later verified at necropsy. As far as can be determined thrombosis of the subclavian vein occurs very rarely in tuberculosis. The monoplegia which results is not permanent, but must be differentiated from a cerebral monoplegia with an associated vasomotor paralysis.

TEMPLE FAY, Philadelphia.

GLIOMA OF THE CEREBRAL HEMISPHERES, A COMPARATIVE STUDY OF TWO CASES. TOM BENTLEY THROCKMORTON, J. A. M. A. 79:1913 (Dec. 2) 1922.

In both cases reported, the cardinal symptoms of increased intracranial pressure—headache, vomiting and choked disk—were latent features; and it was not until the ventricular current was interfered with through pressure that the general symptoms became evident. In one case, the sudden onset and prodromes of an infectious process simulated epidemic encephalitis; in this case, there was a slowly developing motor paralysis resulting in total hemiplegia and seemingly due to a vascular lesion until pressure symptoms developed. In the second case, the early clinical picture was not unlike that of beginning paresis.

NIXON, San Francisco.

SPINAL FLUID CHANGES FOLLOWING AIR INJECTION. G. HERMANN, Med. Klin. 18:1146 (Sept. 3) 1922.

Hermann reports several cases in which a spinal fluid examination was made before and after injection of air. In a case of general paralysis the first examination showed 16 cells; fourteen hours after the injection of air the cell count was 2,231. This rapidly declined and by the fourteenth day the count was 19. A few weeks later following a second air injection, the number of cells mounted to 754. In a case of dementia praecox with a cell count of 2, there was, following air injection, a count of 11,400, chiefly polymorphonuclear leukocytes. Clinically, this patient showed a meningitis as indicated by the temperature, headache, vomiting and a positive Kernig sign. Five days later there was marked improvement with a cell count of 100.

The author feels that air injection is not without danger. The reaction is probably due to stimulation of the meninges. It is interesting that the reaction is less marked when there is disease than in cases with supposedly normal meninges. Hermann does not wish to be dogmatic as more work of this kind must be done. He thinks it is barely possible that the injection of air may serve as a therapeutic measure, especially in cases of general paralysis and tuberculosis. It, in some measure, resembles the production of pneumoperitoneum in tuberculous peritonitis. The use of gases and narcotic substances

might be suggested, but this must be carried out with extreme care in view of some of the disastrous results which have followed lumbar anesthesia.

MOERSCH, Rochester, Minn.

OCCUPATIONAL THERAPY AS A MEANS OF CONTROLLING DISTURBED PATIENTS. WALTER G. RYON, *State Hosp. Quart.* 7: No. 3 (May) 1922.

Ryon states that the object of occupational therapy is for the sublimation of the activities of the disturbed patient from a pathologic channel to a normal one which gives satisfaction in place of the usual destructive tendencies. This direction of the energy of the patient should not, in the author's opinion, be limited to occupational classes alone, but should include the work of the hospital in any department. Recreation of all types is recommended. Occupational therapy should be used not only in the treatment of the acutely disturbed patients, but also in caring for the chronically disturbed patients who show marked habit deterioration. This work is accomplished by classes of habit training using simple games, marching to music, gymnasium and kindergarten work, wood-sawing, sand-papery, etc. The success of habit training in other state hospitals is referred to, especially the work of Dr. Read in Illinois. The author concludes his article with five abstracts of cases showing the value of occupational therapy in bringing the patient into closer contact with reality.

EBAUGH, Philadelphia.

A CASE OF RETROBULBAR NEURITIS ASSOCIATED WITH SYMPTOMS AND SIGNS OF DISSEMINATED SPINAL SCLEROSIS. H. ARMSTRONG, *M. J. Australia* 2:22 (Nov. 26) 1921.

The author presents a meager case history and evidently reached his diagnosis by exclusion. The patient when 22 years of age, suffered a loss of power in both legs, and some anesthesia in the same region. Recovery occurred in six months. Several years later he temporarily lost power in the left shoulder. At 35 he complained of heaviness of both lower limbs and a numbness in the arms and legs. On examination both patella jerks were exaggerated and there were numerous scattered patches of analgesia over the inner aspects of both arms and legs; speech was slow and slurred but not scanning in type. There were characteristic signs and symptoms of retrobulbar neuritis. The administration of potassium iodid in doses of 0.6 gm. resulted in recovery. In discussing the case, Armstrong reviews its various possibilities and concludes that there must have been an association of retrobulbar neuritis with inflammatory patches in the spinal cord.

POTTER, Mercer, Pa.

NEUROPATHIC ARTHROPATHIES—CHARCOT'S SPINE. J. RIDLON and E. J. BERKHEISER, *J. A. M. A.* 97:1467 (Oct. 28) 1922.

The authors report ten cases of tabetic Charcot's spine. This condition may occur in any part of the spine, but in their experience it was confined to the lumbar spine. Of their patients, only one was a woman. The ages at which the condition was noted varied between 32 and 68 years. The average number of years between the initial infection and the occurrence of the arthropathy was eighteen years. The bony changes show bone destruction, bone proliferation and displacement, usually laterally. Traumatism may accenuate the condition. From the examination of the roentgenograms, it would appear

that there are two types of pathologic changes in these joints: the osteosclerotic or the consolidation type, and the osteoporotic or the rarefaction type. For spinal support, they advise a plaster, leather or celluloid jacket made over a corrected plaster torso.

NIXON, San Francisco.

PACHYMENINGITIS HEMORRHAGICA INTERNA: A STUDY OF FIVE CASES OF NON-TRAUMATIC HEMORRHAGIC SPINAL FLUID. ARTHUR D. DUNN, Am. J. M. Sc. 163:819 (June) 1922.

The author presents five cases that show a striking similarity of symptoms and from which he draws a diagnostic triad. The condition, which is usually associated with syphilis, was found mostly in persons past middle life. One case, however, was in a girl aged 18. Four of his cases gave negative Wassermann reactions.

The combination of a bright red, uniformly bloody cerebrospinal fluid in cases of sudden intense headache with signs of meningeal and root irritation, establishes the diagnosis. The symptoms common to all cases were: Headache, intense, sudden in onset, usually occipital or at the base of the neck; rigidity of the neck; deep hyperesthesia; Kernig's sign; paravertebral tenderness; muscle stiffness and soreness; increased reflexes and Babinski signs. Lumbar puncture relieved the intensity of the headache and this procedure was repeated well into convalescence. The fluid obtained became brown and finally yellowish as the patient improved. Of interest was the fact that, with recurrence of the attacks of severe headache, fresh blood reappeared in the spinal fluid. The persistence of muscle cramps, fatigability, instability, restlessness and insomnia into the late period of convalescence was characteristic of all cases.

TEMPLE FAY, Philadelphia.

EXCESSIVE GOLF FOLLOWED BY MUSCULOSPIRAL PALSY. C. C. WHOLEY, J. A. M. A. 79:2,000 (Dec. 9) 1922.

The patient complained of severe pain to the left of the spine over the lower part of the neck, which would come on as soon as he lay down. There was weakness of all the extensor muscles of the left upper extremity. The man gave a history of an active life, and of being an enthusiastic golf player.

NIXON, San Francisco.

IS THERE A BABINSKI SIGN OF THE HAND? A. RADOVICI, Presse méd. 30:767 (Sept. 6) 1922.

The case described and illustrated here was that of a quadriplegic with marked automatic movements in all four extremities. Pinching the skin, from above the umbilicus to the upper edge of the clavicle, induced triple flexion of the corresponding arm. The palm-chin reflex (of Marinesco and Radovici) was absent. Stimulating the palm, particularly the thenar eminence, with a needle, caused extension of the thumb and fanlike spreading of the fingers. This movement was slow and quite similar to the great toe sign of Babinski.

In this case there was fracture of the atlas and axis with excessive callus, so that the lesion was just high enough to avoid causing a flaccid paralysis of the arm. In ordinary hemiplegia, automatic movements do not occur in the upper extremities, and the "Babinski sign of the hand" is not found.

HUDDLESON, New York.

THE NORMAL SELLA. C. D. ENFIELD, J. A. M. A. 79:934 (Sept. 16) 1922.

From a study of the roentgenograms of the sella turcica in 100 consecutive cases, excluding cases of definite endocrine disturbance, the author concludes that the sella turcica in the normal person may vary both in size and in contour within very wide limits; that the average sella, which has usually been interpreted from the roentgen-ray findings as being the normal type, constitutes in the neighborhood of 50 per cent. of the general run of cases, and that wide variations from the average are not necessarily accompanied by any indications of pituitary malfunction or disease. He believes that the only definitely and positively abnormal roentgenographic finding is clear evidence of erosion of the bony structures.

NIXON, San Francisco.

MENTAL FACTOR IN VISCEROPTOSIS. W. H. B. STODDART, Lancet 1:69 (Jan. 14) 1922.

The author calls attention to the common association of anxiety states, visceroptosis and mobile right kidney. In explanation of the mechanism, Stoddart says that any anxiety or fear state produces an excess of epinephrin, which stimulates the gastric sphincter and results in food retention and gastric fermentation, which finally causes gastropptosis with secondary visceroptosis. He believes that all patients with anxiety neurosis and hysteria should be examined for evidence of visceroptosis.

POTTER, Mercer, Pa.

THE TREATMENT OF RESIDUAL EPIDEMIC ENCEPHALITIS.

GEORGE H. HYSLOP, J. Neurol. & Psychopath. 3:250, 1922.

Fifteen cases of the parkinsonian type of encephalitic residua were studied in relation to their reaction to drugs. With the exception of opium, the only results of value were secured from the administration of scopolamin or gelsemium, the former yielding improvement in 75 per cent. of the cases and the latter in 66 per cent. Two patients seemed to recover under the influence of gelsemium.

SINGER, Chicago.

PSYCHOSES ASSOCIATED WITH SYDENHAM'S CHOREA. E. M.

HAMMES, J. A. M. A. 79:804 (Sept. 2) 1922.

In a series of eighty-eight cases of Sydenham's chorea, the author noted definite symptoms of a psychosis in eighteen of the patients. The mental picture showed considerable variation, except that frequently distressing hallucinatory ideas were present. The mental picture conforms to that observed in toxic psychosis.

NIXON, San Francisco.

Society Transactions

NEW YORK NEUROLOGICAL SOCIETY

Stated Meeting, Dec. 5, 1922

FOSTER KENNEDY, M.D., *President, in the Chair*

CASES ILLUSTRATING SOME ASPECTS OF BRAIN AND SPINAL CORD TUMORS. CHARLES A. ELSBERG, M.D.

Case 1. The first case was a patient on whom laminectomy had been performed, with removal of an extramedullary leiomyoma at the level of the second and third cervical segments, secondary to a tumor of the neck which had been removed eighteen months previously. The man, a civil engineer, aged 53, was admitted to the Neurological Institute Jan. 2, 1922. For a number of years he had suffered with neuralgia of the left side of the face, which was relieved by the extraction of some of his teeth. In 1915, he had a small growth on the right side of the neck, which slowly increased in size and was accompanied by pain in the back of the neck. In 1920 he was operated on by Dr. John Worcester of New York. At this time, the tumor was as large as a hen's egg, and was situated in the anterior triangle of the neck on the right side. At the operation, the tumor was found to be underneath the large vessels; it was adherent to the deep muscles of the neck and lay against the transverse processes of some of the cervical vertebrae. The tumor was well encapsulated and in one spot seemed to extend into an intervertebral foramen. The pedicle extending into the foramen was ligated and cut, and the entire growth was removed. The pathologic diagnosis was a leiomyoma of branchiogenetic origin.

A few months before this operation the patient began to suffer from occasional severe pain in the back of the neck on the right side, which radiated up into the head. Six months after the neck operation, he noticed that the right index finger was becoming weak, and the weakness gradually involved the entire hand and arm. One week later, there was beginning loss of power in the right lower extremity. About this time the left lower extremity, and later the left upper extremity, became weak. In August, 1921, laminectomy was performed in the lower cervical and upper thoracic region but no tumor was found. The patient did not improve after the operation, and his symptoms steadily progressed. The pain in the neck which was continuous, became very severe, so that he could not move his head in any direction. At times he had an exquisitely cold sensation in the hands and feet, especially on the right side. The weakness in the limbs gradually became worse and he was bedridden for two months, with almost complete loss of power in both upper and both lower extremities. For a month before admission to the hospital he had incontinence of urine and feces.

When admitted to the hospital, physical examination revealed a tall, strongly built man who was considerably emaciated; he was delirious at times and complained of great pain in his neck. The right pupil was slightly smaller than the left, but both pupils reacted promptly to light and accommodation;

the fundi were normal, although the retinal veins were somewhat overfilled. In the right upper extremity power was absent at the shoulder, elbow and wrist. Slight flexion and extension of the fingers were possible, but the movements of the index finger were slight. In the left upper extremity, slight abduction and adduction at the shoulder, and slight flexion and extension at the elbow were possible; good power was present at the wrist; flexion of the fingers was fair, but extension of the fingers was weak; pronation of the forearm was weak, and supination of the forearm was absent. The pectoral reflexes were weak on the right, normal on the left. The biceps and triceps reflexes were markedly exaggerated on both sides. The radial and ulnar reflexes could not be elicited on the right, and were weak on the left. There was complete loss of power in the abdominal muscles and the cremasteric reflexes could not be elicited. The right lower extremity was decidedly weaker than the left, and the power in both limbs was greatly diminished. The suprapatellar, patellar and Achilles reflexes were weak on both sides, and a Babinski reflex was present on both sides.

The disturbance in tactile, pain and temperature sensibility involved the entire body, from the second cervical segment downward. Disturbance in joint and vibratory sensibility involved the greater part of the body. There was marked tenderness on pressure over the upper cervical spinous processes.

Roentgen-ray examination was negative. Lumbar puncture produced a clear fluid containing six cells to the cubic millimeter. The globulin reaction was +++; the Wassermann test was negative.

Jan. 7, 1922, a laminectomy was performed, with removal of the arches of the second, third, fourth, and part of the arch of the fifth cervical vertebrae. Incision of the dura exposed a well encapsulated tumor, which was firmly adherent to the dura, and about 3 by 2 cm. in size. It was situated at the level of the second cervical segment, ventrolateral in position, and on the right side. Into it ran the third cervical root. The tumor had a projection which extended through the dura at the level of the intervertebral foramen between the second and third cervical vertebrae, but there was no evidence of tumor on the outside of the dura. The third cervical root on the right side was divided inside the dura and the tumor was removed entire with its capsule. The cord had been pushed markedly to the left and was much flattened; the arachnoid was distended above and below the tumor.

Improvement in the power of the upper limbs was noted by the patient as soon as he awoke from the anesthesia, and the return of power and sensation was so rapid that in three weeks he was able to move the right upper extremity with almost normal force, at the shoulder, elbow, wrist, and all finger joints. The power in the right lower extremity was also greatly improved. The left upper and lower limbs could be moved with normal strength in all directions. There was a corresponding improvement in the sensibility of the body. The joint sense disturbances had not improved, but vibratory sensibility had returned in both lower limbs. The patient left the hospital less than seven weeks after the operation. At that time he walked freely without any support, and could use both upper extremities freely and well. The cutaneous sensation over the body and extremities was only slightly disturbed. He has since steadily continued to improve.

The examination of the tumor removed from the patient's neck in 1920, was reported as follows: "The tumor measured 4 by 2 by 2 cm. and was well encapsulated; it was moderately firm in consistency, and on gross section showed mottling of light yellow with grayish-white translucent areas. Micro-

scopically, the principal elements were smooth muscle cells, closely packed in bundles, and fat cells of the embryonal type; there was a moderate amount of fibrous stroma; the cells were uniform in size, did not exhibit anaplasia and no mitotic figures were seen. Diagnosis: leiomyoma."

The intradural growth was also well encapsulated; it showed at one end a knob-like projection where it had extended through the opening in the dura for the third cervical root. Microscopically, the growth was the same as, but more vascular than, that of the tumor removed from the neck.

This was a very unusual case of a growth which began in an intervertebral foramen and grew outward between the deep structures of the neck. When the tumor of the neck was removed, a ligature was placed around its pedicle, which extended into an intervertebral foramen. The scar tissue which resulted, prevented a recurrence into the neck, and the growth then extended inward, through the opening in the dura for the third cervical root, and formed an intradural tumor in that location.

Case 2. Dr. Elsberg presented a patient on whom he had operated for extradural fibrosarcoma, and who had completely recovered. The patient, a girl, aged 16, was admitted to Mt. Sinai Hospital on April 19, 1921, with a history of pain for two years on the left side of the chest, behind and beneath the angle of the scapula. The pain became so severe that for a time she required large doses of anodynes. Two months before admission, her left leg became weak and stiff, and a few weeks later the right lower extremity became similarly affected; she also noticed that the feeling in the right lower extremity was not as good as formerly. The weakness and stiffness of the lower limbs, and the diminution in sensibility of the right leg, grew rapidly worse, so that the patient could walk only with great difficulty and could not stand without support. For one month she was unable to empty her bladder, and a catheter had to be used.

Physical examination showed that the abdominal reflexes were very weak on both sides. The left lower extremity was much weaker than the right. The knee jerks were much exaggerated; there were: double patellar clonus; double, inexhaustible ankle clonus, and a Babinski sign on the left side. The fifth thoracic spine was very tender, especially when pressure was made on it from the left. There was a marked diminution of tactile, pain and temperature sensation on the right side below the fourth thoracic segment, and a sensory disturbance on the left.

The roentgen-ray examination was negative. Lumbar puncture produced a clear fluid with 5 cells to the cubic millimeter; the globulin was not increased and the Wassermann reaction was negative.

On April 11, 1921, a laminectomy was performed, with removal of the arches of the fourth, fifth and sixth thoracic vertebrae. On the posterior and left side of the dural sac, and adherent to it, was a well encapsulated tumor measuring about 4 by 1 cm. The tumor was of firm consistency, not very vascular, and did not involve any of the nerve roots. It was removed in several pieces together with part of the transverse process of the fifth thoracic vertebra and a piece of the dura. Pathologically, the tumor was a fibrosarcoma which contained a large number of foreign body giant cells.

After the operation there was rapid improvement. Complete control of the bladder was regained within one week. All sensory and motor symptoms disappeared within six weeks. For several months the patient complained of slight pain in the back, but this gradually disappeared. She received roentgen-ray treatment at regular intervals. Eight months after the operation she had

gained 20 pounds in weight and felt perfectly well. Eleven months after the operation roentgen-ray examination revealed a small shadow to the left of the area of the former operation. This shadow had increased in size. There were no subjective or objective neurologic disturbances. An incision was made through the old wound which exposed and permitted the removal of a bony tumor, which was evidently callus, from the region of the former operation. There was no evidence of recurrence of the growth. Pathologic examination of the tumor showed newly formed bone with no evidence of fibrosarcoma. At the present time the patient is free from all symptoms.

Case 3. Dr. Elsberg presented a boy who had been admitted to the service of Dr. F. Tilney at the Neurological Institute in January, 1922. He had been perfectly well until May, 1921, when he had an attack of pain in the right side of the chest which extended upward into the head. In June, he had a second attack and with this a sensation as if his right arm was contracting. Between these attacks he had minor seizures of the same nature. During the following month he had four severe seizures, all beginning with a pain in the lower part of the thorax. The case has been fully reported by Dr. H. A. Riley in the *Neurological Bulletin*. The signs pointed to a tumor in the left superior parietal lobule; at the operation a large angiosarcoma, 5 by 6 cm. in size, was removed from the superior parietal lobule, behind the Rolandic fissure. The tumor was well encapsulated, but was not clearly differentiated from the cortex in the deeper areas. The patient is now almost free from symptoms. Except for one convulsive attack he has been well since the operation.

Case 4. Dr. Elsberg presented a patient from whom he had removed a large endothelioma of the anterior part of the left temporal lobe in August, 1922. The tumor had given rise mainly to mental disturbances and subjective sensations of numbness in the left hand. The patient recovered completely and has remained well.

Case 5. Dr. Elsberg also presented a left-handed man, from whom he had removed a large tumor of the right frontal lobe eighteen months before, with very satisfactory recovery.

In connection with these cases Dr. Elsberg presented a number of very large brain tumors, both cortical and subcortical, which had been removed during the past year from patients on the service of Dr. Tilney at the New York Neurological Institute. All of these patients recovered from the operation.

DISCUSSION

DR. F. TILNEY: One point to be noted is the large number of endotheliomas in this group of cases. This is surprising if we remember that they represent a collection of cases which have occurred within the last twelve months. It is rather unusual to see such a number of surface tumors which are accessible. The general tendency of this group is to affect certain parts of the brain, namely, the frontal and prefrontal areas. In the case with acrognosis and astereognosis there was a typical cortical anesthesia. The growth itself extended back into the parietal lobe, but the involvement was mainly of the frontal and prefrontal areas. I would like to speak of the group method employed in the diagnosis which has proved to be of very distinct value. Each case was thoroughly presented and discussed by the five men who had studied its various phases. We did not use ventriculography, for the results without that procedure were satisfactory in regard to localization.

DR. FOSTER KENNEDY: In the frontal tumor case, was the blindness in the left eye due to pressure on the optic nerve?

DR. F. TILNEY: Some years before symptoms began this man was examined for fitness to do motorman's work. There was found, at that time, a defect in the left eye, so that this symptom should not be attributed to the neoplasm. He was rejected for motorman's work after that examination. He is left-handed, which, I think, explains the fact that there was no aphasia.

DR. M. A. STARR: In the neurologic examination of the elderly woman, was there any appreciable mental change, such as loss of memory, or slowness of thought, in connection with the development of pressure on the right frontal lobe?

DR. F. TILNEY: There was considerable mental disturbance prior to the operation. That was the most outstanding feature of the case. The patient had loss of memory for recent events and some obscuring of remote memory. After the operation there was marked euphoria. This gradually subsided. Her husband says that since the operation she has undergone a complete change in disposition. Her memory has returned and she has been able to carry on efficiently the management of her household.

STUDIES IN FOCAL INFECTION: ITS PRESENCE AND ELIMINATION IN THE FUNCTIONAL PSYCHOSES. NICHOLAS KOPELOFF, PH.D., by invitation, and C. O. CHENEY, M.D.

The conclusions from this study of the relation of focal infections to functional psychoses may be summarized as follows: (1) The removal of infected teeth and tonsils from twenty-seven cases showing manic-depressive, dementia praecox, and psychoneurotic reactions, has been followed by no more mental benefit than was observed in a comparable group of thirty-three patients from whom such hypothetical foci of infection were not removed. There were no recoveries or distinct improvements other than those to be expected, irrespective of focal infection. (2) The Rehfuess method of fractional gastric analysis is not to be relied on as a means for determining gastric infection. The bacteria found in the stomach contents by this method may be derived largely or entirely from the swallowed saliva. (3) Chronic constipation may be relieved by means of milk fermented by *bacillus acidophilus*, reinforced with lactose. (4) These studies are being continued, not only for the purpose of obtaining further facts about focal infection in the psychoses, but as part of a general plan to afford psychotic patients every available opportunity for benefit.

DISCUSSION

DR. HENRY A. COTTON: The work of Drs. Kopeloff and Cheney bears a striking resemblance to ours at Trenton in 1916, and the results are what might be expected. In the first fifty patients whose teeth were extracted and tonsils removed we obtained no results. There are two reasons for this: first, the work was limited to the teeth and tonsils; second, we selected our cases and were disappointed in the results. It was not until 1918 that we began to examine every case admitted in a systematic, routine manner. At the end of 1918, we found we had produced results. The authors have had our experience to guide them, but apparently have not benefited by that experience. I have talked this matter over with them, but they seem to ignore the facts and insist on considering that their work in a way offsets ours of the last four years. The error in their work is evident to anyone who gives

the matter consideration. In the first place, in very few patients, especially in women, is the infection limited to the teeth and tonsils. Eighty per cent. of the women have gynecological infection, mostly in the cervix, and at least 50 per cent. of both sexes have secondary foci in the stomach which must be treated by vaccine or specific serum.

Dr. Kopeloff claims to have made a very exhaustive investigation of gastric infection and is inclined to dispute the results obtained by Rehfuss and by us. The principal point in dispute is the origin of the bacteria found in the stomach. He makes the claim, from what I think is insufficient evidence, that the bacteria found in the stomach by the Rehfuss method come entirely from the saliva which is swallowed when the test is made. In order to decide this point we made cultures from the saliva in the mouths of 106 patients at the same time that the stomach test was made. In only fourteen cases did we find any relation between the bacteria in the saliva and the bacteria in the stomach. That is, in these fourteen cases, the bacteria in the two localities were identical and were limited to one type of streptococcus. In the other ninety-two cases, entirely different strains of streptococci were found in the mouth as compared with the stomach. In some cases the same strain was found in both, but there were other strains as well. This tends to disprove Kopeloff's contention without doubt, and also to substantiate the work of Rehfuss.

There seems to be little reason for this report. Twenty-five cases are entirely too few on which to base an opinion; and the work which has been done on them has been entirely inadequate. Such work does not explain the success of the methods at the State hospital at Trenton. In the last four years 1,400 cases have been treated successfully, and have been considered as recovered when they were discharged. Of this number only sixty-two have been returned and are now in the hospital. The question might be asked: How do we know that these cases, some of them after four years, are still well? The answer is simple for the patients are visited regularly by field workers and reports are obtained at least twice a year. These patients have been thoroughly detoxicated and all infection has been eliminated by surgery, where possible, and, in addition, by autogenous vaccines, and antistreptococcic and anti-colon serums.

It is easily demonstrated from our work that the mere extraction of a few teeth and the enucleation of a few tonsils will not produce results. In this so-called functional group, our records show that, for a period of ten years, 37 per cent. recovered spontaneously. In the last four years the recovery rate in the same group, where treatment has been energetically applied, averages 85 per cent. These are facts which cannot be controverted.

We do not include in these 1,400 patients, 250 who have left the hospital unimproved. The majority of these were received from other institutions and the psychoses had been of such long duration that nothing could be done for them. These patients frequently return to the institutions from which they came and, of course, serve as an object lesson for the poor work done at Trenton. At least six State hospitals are following our methods and are obtaining similar results. While it is disappointing to have this report from Ward's Island, we nevertheless, feel that it in no wise decides the question.

DR. G. H. KIRBY: The revival of interest in the study of the physical condition of patients suffering from mental and nervous disorders is an important forward step in psychiatric work. It cannot be denied that in some quarters at least there has been a tendency to neglect the somatic aspect of

mental disorders while the psychogenic viewpoint has been pushed to the front. The idea that nervous and mental affections of the functional type are due primarily to some bodily disorder or toxemia is, of course, a very old one in psychiatry. But up to the present there have been few, if any, well controlled scientific observations which tended to confirm this hypothesis. Aside from a very small group of psychoses, practically nothing has been established to show a definite etiologic relationship between toxemia and mental disturbance. In much larger groups of mental and nervous affections the same cause has been rather widely assumed to exist. Such assumption, however, was based almost solely on empirical observations and the apparent effect on patients of certain methods of treatment. The nature of the problem has made the proving or disproving of etiologic relationships a very difficult matter. Naturally, a wide interest was at once aroused in recent claims that the problem had been solved; that there was no essential difference between the clinical groups of dementia praecox, manic-depressive and the psychoneuroses; that they all have a common and a relatively simple cause—namely an infection in some part of the body—which leads to a slow poisoning of the central nervous system, with the result that neurotic and psychotic symptoms appear. It has been claimed that a mild toxemia produces a mild or benign psychosis (manic-depressive or psychoneurosis), whereas a severe or prolonged toxemia leads to dementia praecox.

On grounds of clinical experience it is difficult to accept such a generalization, which sweeps away the whole structure of clinical distinction based on symptomatology, course and outcome of these mental affections, and ignores all that has been established regarding the rôle of personality and psychogenesis in functional nervous and mental disorders. One must, therefore, insist on a careful scientific working out of the questions at issue under conditions in which chances for error are reduced, the permanency of results is established, the personal equation is eliminated, and a comparable control material is carefully studied. Dr. Kopeloff's communication is a preliminary report on the way in which the work is being conducted at the Psychiatric Institute. Our purpose has been merely to state our findings after a careful study of the problem up to the present time. A larger clinical material is being investigated and a report will be given later.

DR. M. OSNATO: What is our attitude to be when these patients have foci of infection?

DR. F. H. DIETERICH (by invitation): What is the proportion of infected teeth in the general admissions to psychiatric institutions? And what is the cause of the insanity when there is no focal infection?

DR. C. E. GIBBS (by invitation): I have been closely associated with Dr. Kopeloff and am familiar with his work. It is necessary to establish definitely what constitutes a focus of infection outside of the teeth and the tonsils. It remains to be demonstrated that bacteria free in the stomach are a source of infection or intoxication. Are they any more a focus of infection than are those free in the mouth, in the saliva? Dr. Cotton stated that 80 per cent. of his female patients have infection of the cervix. One of Dr. Cotton's associates recently stated at a meeting that any cervical discharge meant a focus of infection. I do not think that belief will be generally accepted.

DR. G. H. HYSLOP, by invitation: Dr. Cotton stated that infection of the cervix is very common in the psychoses of women. I heard Dr. Maxwell say that the bacteria found in the cervix originated in the tonsils, and that they reached the cervix through the blood stream and lymph channels. They

might go by the blood but I do not see how they could reach the cervix by the lymph paths. The most direct way would be along the intestinal canal. It is really remarkable how very few clear-cut functional psychoses result from infection. This does cause delirium or mental confusion, but the number of manic-depressive or dementia praecox cases is negligible. It may be that infection precipitates an attack. We have seen a number of Dr. Cotton's patients, many of whom have returned with the handicap of lack of teeth. In regard to erosions of the cervix, it is remarkable how many women have erosions and discharges; yet relatively few of them develop psychoses. I believe that the value of Dr. Cotton's work is that he has called attention to the mouth, tonsils, and colon; surely stomach infection is rare. Prior to his work the teeth and mouth were utterly neglected, but I do not think that all his claims are justified.

DR. L. PIERCE CLARK: The issue at stake in Dr. Kopeloff's presentation is much broader than the question whether a focal infection was a causative factor in the type of cases presented here, or even in the more extensive work of Dr. Cotton, previously reported. The question arises whether the psychoneuroses and psychoses are caused by focal infections or by any other type of infection. Does their etiology rest on such a cause as is popularly stated in textbooks and taught in the medical school, or have they a causation on more fundamental biologic or psychobiologic principles, such as makeup, and difficulties in life adaptations? Dr. Cotton, in particular, refuses the latter any place in etiology, and places emphasis on purely somatic and local infective agents. I believe such a view is wrong; it runs counter to all conceptions of psychogenesis and mental pathology. These rest on too firm a scientific foundation to be thus uprooted. The whole movement of focal infection in psychoneuroses, while in the immediate interest of good internal medicine in mental hospitals, is a regressive tendency as it gives mental pathology a secondary place in the domain of psychiatry.

DR. KOPELOFF, closing: It is hardly fair for Dr. Cotton to say that our results are identical with those he obtained in 1916, if for no other reason than that we have no detailed report of those results. It is true that in some of our patients examined by Dr. Cotton there were tonsillar remnants. This is not unusual, even in Trenton. The tonsillar remnants were removed after Dr. Cotton saw these patients and yet their condition has remained the same. Dr. Cotton claims that bacteria in the stomach cause a low gastric acidity, but a very careful examination of his tables in an article recently published in the *American Journal of Psychiatry* (October, 1922), reveals the fact that streptococci were found irrespective of high or low degrees of acidity. With regard to his attempts to disprove the claim that bacteria in the stomach come to a large extent from the saliva, his technic is open to severe criticism. We plated out the bacteria quantitatively at once. Dr. Cotton puts a sample in broth and then incubates. This permits one kind of organism to predominate, and one cannot tell on the following day what types of organisms had been present on the day before. Our criticism of Rehfuss rests on two grounds: first, that the gastric contents are not homogeneous, and second, that a single fractional gastric analysis is insufficient ground on which to base a conclusion as to the gastric acidity. Gorham, Wheelon, and White have furnished additional evidence along these lines. With regard to operative procedure, we did not neglect operations when necessary, but we did not operate without adequate indication. Dr. Cotton remarked that we cannot cure colon lesions with acidophilus milk. We did not claim this, but stated that we could relieve

chronic constipation by this means, and this removes Dr. Cotton's cardinal symptom for abdominal surgery. Dr. Hyslop and Dr. Gibbs have already discussed infection of the cervix as it was presented last month by Dr. Langstroth. It is sufficient to state that he claims to cure, not only functional psychoses by enucleation of the cervix, but also epilepsy and even feeble-mindedness. In answer to the question whether or not one should eliminate focal infections in psychotic patients, I believe we agree that all infections should be removed. However, what influence this will have on the psychosis is another matter. That, indeed, is the reason for our work.

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

Regular Monthly Meeting, Dec. 21, 1922

E. W. TAYLOR, M.D., *in the Chair*

CASE OF CEREBELLAR TUMOR: OPERATION: RELIEF OF SYMPTOMS. DR. E. W. TAYLOR.

This case is presented because of the purity of the cerebellar symptomatology. Apart from certain signs of general increased intracranial pressure, there are absolutely no indications of cranial nerve paralysis or other neighborhood symptoms. The patient was well so far as he knows until three months ago. He then had a certain difficulty in the management of the left leg with a slight tendency to limp and to turn toward the left in walking. A week after the onset he noticed clumsiness of the left hand. These signs increased in severity. He was admitted to the Massachusetts General Hospital about two months after the onset. For several days previously he had vomited excessively, for the most part irrespective of food, and often in a projectile manner. He had also had considerable vertigo, which he at times somewhat vaguely described as headache. He was mentally clear during this period. The physical examination at the hospital revealed normal reflexes and sensation. The optic disks were slightly clouded. He was much disturbed by a sense of vertigo and occasional vomiting. There was horizontal nystagmus in both eyes on lateral fixation. His strength was unimpaired, but there was very marked disturbance in the left side, characteristic of cerebellar asynergy. Dysmetria, adiodokokinesia, Holmes' rebound phenomenon in less degree, and past pointing toward the left, were all markedly present. He became unable to walk without assistance, and when helped had a strong tendency to go toward the left. He stood as well in the Romberg position with open as with closed eyes. The sphincters were at no time involved and he remained mentally clear.

The diagnosis of left cerebellar hemisphere lesion was made, presumably a tumor, possibly a cyst. Operation by Dr. W. J. Mixer, November 29, after exposure of both cerebellar hemispheres revealed very marked pressure with particular bulging on the left side. Incision of the hemisphere led to the evacuation of a considerable amount of yellowish fluid. Palpation revealed a tumor which proved to be gliomatous in character. After the operation the patient improved considerably in his general symptoms from the relief of pressure. The cerebellar signs, however, persist, but in somewhat less degree,

Treatment by roentgen-rays may relieve the situation, but the prognosis is obviously grave.

An unusual feature of the case is the absence of choked disk in spite of extreme intracranial pressure. The rapidity of development of the tumor is also noteworthy, and is probably to be explained by a secondary cyst formation.

DISCUSSION

DR. W. J. MIXTER: The tumor in this case was seated deeply beneath the cortex of the cerebellar hemisphere, and was associated with a cystic cavity. The tumor was soft, friable, and impossible to remove. Under microscopic examination it proved to be a glioma.

DR. H. C. SOLOMON: I would like to ask what is the value of roentgen rays in the treatment of a case of this type.

DR. W. J. MIXTER: I am not enthusiastic about the effect of roentgen rays in this case. In general, however, I am convinced that it helps in many instances, particularly in the soft, embryonic type of tumor.

CHRONIC LEAD POISONING VERSUS TABES DORSALIS. DR. GEORGE CLYMER.

This case is one of long-standing disability which has given rise to considerable difference of opinion as to its cause. The patient is a man aged 55, who was in the Massachusetts General Hospital from Oct. 22, 1919, to Dec. 8, 1919. His occupation for thirteen years was that of a sign painter, but for ten years he was unable to work, and during that time there was no history of exposure to lead. The past history contains a record of an accident at the age of 20 in which his right knee was crushed; since then it has been weak. There was a venereal discharge for two weeks sixteen years ago but syphilis is denied. His wife has had two miscarriages and there are no living children.

He complained of: (1) Abdominal pain, located in the region of the umbilicus, two to three times a week; it came on ten to fifteen minutes after meals and was gnawing in character. It would disappear for three to four months at a time and then return more severely. (2) Dizzy attacks without loss of consciousness about once a month in which he fell to the floor, but recovered after a minute or two. (3) Pain in the extremities of ten years' duration, with a tingling sensation in one foot and leg, and pain "like being squeezed in a vise" in the other leg. This pain was constant, but there were periods of more severe pain which lasted two and a half hours, and occurred at first every two to three weeks, recently every three to four days. (4) Dyspnea and palpitation of the heart without edema, for ten years; orthopnea at night. Eight years ago he was told that he had heart trouble, and ten years ago that he had lead poisoning. (5) A stabbing precordial pain with a sensation of numbness in the left arm which began four months ago. Belching of gas, constipation and nausea for the past two months.

While in bed in the hospital the dizziness disappeared but the other symptoms, especially the abdominal pain, became worse. He also said that he had had a dry cough for months, and had noticed that his voice was growing hoarse.

Physical examination at the time of admission revealed a larger pupil on the right than on the left; both were regular and reacted to distance but not to light. Many teeth were missing. There was no lead line on the gums.

The spine presented a double right scoliosis. The apex impulse of the heart was seen and felt in the fifth space; the rate was slow and there was an occasional extra systole; the sounds were of poor quality and there was a late systolic murmur; the second aortic sound was not heard; the first sound at the apex was sharp and loud; there was no diastolic murmur. The pulses were equal and of good tension. The artery walls were palpable. In the abdomen there was a suggestion of a mass in the epigastrium; liver dulness extended from the fifth space to 5 cm. below the costal margin; the edge was felt three finger-breadths below the costal margin and was not tender. The right knee presented a very resistant swelling and the patella was dislocated toward the right. The knee jerks were absent; there were neither clonus, nor Babinski or Kernig signs. Through the rectum a large, boggy but not tender prostate was felt.

The laboratory findings were: Blood Wassermann test negative. Lead positive in the urine. Functional kidney tests: October 24, 10 per cent.; October 25, 25 per cent.; October 28, 40 per cent.; October 31, 5 per cent.; November 3, none; November 23, 60 per cent. The blood count revealed: white cells, 4,400; red cells, 3,972,000. In blood smears no stippling was seen in three examinations; the red and white cells appeared normal. The nonprotein nitrogen was 54.32 mg.; creatinin, 1.3 mg. The stools contained lead. The spinal fluid was clear and under normal pressure; it contained no cells and protein and globulin tests were negative. The Wassermann reaction was negative. The roentgen-ray examination was entirely negative. A bismuth enema revealed an extra loop in the descending colon, but no other abnormality.

During his stay in the hospital on that occasion, he was seen by eleven consultants from the surgical and neurologic departments, the department of industrial medicine, and the department of syphilis and gastro-enterology. The opinions recorded varied from a positive diagnosis of lead poisoning to a positive diagnosis of tabes dorsalis, and a diagnosis of combined lead poisoning and tabes.

He has now returned to the hospital with a definite Charcot knee. The other symptoms are much as they were in 1919. He came to the hospital now because while walking, on the day before admission, he felt as though something had slipped in his knee, and he has been unable to bear weight on it since. The laboratory findings now are: The blood Wassermann is negative; lumbar puncture yielded 10 c.c. of clear fluid under normal pressure which contains 6 cells; the alcohol precipitate is positive, the ammonium sulphate negative; total protein, 44 mg.; the goldsol reaction is 0123321000; the Wassermann reaction is negative. The urine is negative. Blood examination reveals: polymorphonuclears 59, lymphocytes 36, large mononuclears 5; the red cells are slightly achromatic; the platelets are normal. Stool examinations are negative.

Roentgenograms bear out the clinical diagnosis of Charcot knee and the lancinating pains which he has now are characteristic of tabes.

It now appears that the laboratory tests for lead which were made at the time of his previous admission would be positive not only with lead but also with manganese, so that the laboratory reports that lead was present cannot be taken as conclusive. In the absence of other evidence of lead poisoning, or of exposure to lead within the past ten years, it is probable that lead can be ruled out as a factor in the clinical picture at that time. The serologic findings then and now are characteristic of a relatively inactive stage of tabes in which Charcot joints frequently develop. These cases unfortu-

nately respond little if at all to antisyphilitic treatment. At the suggestion of Dr. J. B. Ayer, the patient has been given sacral injections of 65 c.c. of physiologic saline solution which have relieved the pain.

This case emphasizes the point that it is easy to be led astray by laboratory findings. On his first admission they apparently demonstrated the presence of lead and the absence of syphilis. We now believe that lead was probably not a factor in the case, and that the picture was due entirely to syphilis.

HYOSCIN IN PARKINSONIAN RIGIDITY. DR. GEORGE CLYMER.

This man, aged 22, was suddenly taken sick three years ago with headache, fever, sleepiness, weakness, dizziness, and diplopia. He was then in bed for three days. The symptoms gradually passed off, but in the course of a month or two it gradually became difficult for him to take deep breaths. Eighteen months ago he noticed a slowness of all movements, although there has at no time been any mental retardation.

When first seen here he presented a typical picture of Parkinson's disease, with even a slight tendency to drool. He was admitted to the hospital for serologic and other examinations, which resulted thus: The urine was negative. The blood was normal and the blood Wassermann reaction negative. On lumbar puncture 10 c.c. of clear colorless fluid was withdrawn which revealed cells 2; ammonium sulphate test negative; alcohol test negative; Wassermann test negative; goldsol test, 0000000000; total protein, 45 mg.; pressure normal; sugar 0.0625 mg.

The treatment has been: December 16 and 17, hyoscin hydrobromid, $\frac{1}{150}$ grain (0.0004 gm.) subcutaneously three times a day; December 18 and 19, hyoscin hydrobromid, $\frac{1}{100}$ grain (0.0006 gm.) subcutaneously three times a day; December 20, hyoscin hydrobromid, $\frac{1}{100}$ grain (0.0006 gm.) by mouth three times a day. As a result he now shows no rigidity whatever, and his movements are normal. He also feels well. I do not think that permanent benefit has been derived from the treatment, but offer the case simply to show the palliative results which may be obtained.

BROWN-SEQUARD PARALYSIS FROM DISLOCATION OF CERVICAL VERTEBRA. DR. HENRY R. VIETS.

A boy, aged 16, struck his head on the bottom when he dived into a shallow pool, and was stunned but not unconscious. Immediately and for some weeks afterward he suffered from severe, sharp, and intermittent pains in the neck, upper part of the back, and arms, which caused him many sleepless nights. He could not raise his arms above his head, and the movements of the hands were awkward and clumsy. His fingers, as well as the lateral aspects of his thighs, were numb. Micturition was not affected. He walked with his head forced forward in a semi-flexed position and was unable to turn it to the right or left. Roentgenograms in the anterior-posterior position were taken before he entered the Massachusetts General Hospital, but failed to reveal fracture or dislocation.

When seen at the hospital two months after the injury, he carried his head in the position described. No definite dislocation was noted in the anterior-posterior roentgenograms, though the space between the fourth and fifth cervical spines was increased without lateral displacement. The lateral plates, however, showed a forward displacement of the fourth on the fifth cervical vertebra, without fracture. The pupils were equal. The triceps and radial

reflexes were active and equal, but the biceps jerk could not be obtained; the whole of both arms, except the hands, showed some weakness. Both legs were slightly spastic, with both knee jerks increased, bilateral ankle clonus, and suggestive bilateral Babinski signs. There was also some swaying in the Romberg position. Questionable hypesthesia of patchy distribution was demonstrated over the upper third of the left thigh.

At the operation by Dr. W. J. Mixter, three and one-half months after the injury, bilateral forward dislocation of the fourth on the fifth cervical vertebra was disclosed, with pressure on the spinal cord by the laminae of the fourth. The vertebrae were strongly fused and could not be moved laterally by manipulation, nor did traction change their relation. Laminectomy of the third and fourth cervical vertebrae was done. Now, three months after the operation, the patient's condition is greatly improved, his head is straight and can be flexed and rotated, at least in part, without pain. He has a partial Brown-Séquard paralysis; the right side of the body is partly anesthetic, especially for pain and temperature sensibilities, up to the level of the fourth cervical segment, and the line of demarcation is fairly sharp. On the left side there is spasticity of the leg, with increased reflexes, ankle clonus, and a Babinski sign. The arms have no definite sensory loss, though there is some paresthesia of the fingers. Both deltoids and both biceps muscles are weak, but they respond to faradic stimulation and have slightly improved.

The Brown-Séquard paralysis clearly points to a lesion in the fifth cervical segment of the spinal cord, more definite on the left than on the right side. This localization also corresponds to the paresis of the arm muscles. The diaphragm does not seem to be involved, and this suggests that the fourth segment was not seriously injured. The Brown-Séquard paralysis is of the usual incomplete type, with paresis on the side of the lesion, associated with spasticity and loss of muscle and joint sense, and a contralateral loss of pain and temperature sense. There is diminution of the sense of touch on both sides.

In studying the roentgenograms I lay special emphasis on the value of the lateral exposure as essential to the diagnosis of the lesion. Roentgen-ray examination made before the patient entered the hospital failed to reveal the dislocation because it was limited to the anterior-posterior field.

DISCUSSION

DR. W. J. MIXTER: This case presents one very definite lesson: the danger of spinal cord surgery when moderate pressure is already being exerted on the cord. I used the utmost care in removing the upper laminae which were pressing against the cord, and yet I increased the paralysis very much.

Another point is that after a dislocation of the neck has existed for some months, bony union takes place to such an extent that it is impossible, except by actually cutting the bodies apart, to reduce the dislocation. This is obvious in the roentgenogram in which the bony union is apparent.

VERTIGO AND ITS TREATMENT. DR. C. L. WOOLSEY.

Vertigo is the result of stimulation of the vertiginous centers in the cerebrum through the vestibular end-organ, its tracts, or associated tracts. Vertigo is of two types: subjective, when the individual experiences a sensation of posture change in relation to the objects about him; and objective, when the objects seem to change their position in relation to the individual.

It may be accompanied by a disturbance in the emotional realm or by giddiness, nausea and vomiting. It is essential to ascertain exactly what the patient means by "being dizzy"; frequently, visual blurring is mistaken for vertigo. Vertigo may be caused by injuries to the vestibular end-organ or to its tracts.

CASE 1.—Mr. S. came to the neurologic department of the Massachusetts General Hospital on account of attacks of severe vertigo accompanied by nausea and vomiting. Several weeks previously he had fractured the base of the skull and had profuse bleeding from both ears and from the nose. After several weeks he returned to his former position as locomotive engineer, but experienced severe vertigo and vomiting when taking curves. The neurologic examination was negative with the exception of tinnitus in the left ear and a left horizontal nystagmus. The fundi were negative.

The treatment in this case began by rotating the patient morning and night in the horizontal plane. Three complete rotations of the body were followed by rest in bed; each successive day the number of rotations was slowly increased, so that the patient learned to accommodate himself to the stimulus producing the vertigo. After six weeks treatment he was able to resume his duties as locomotive engineer and since has experienced little or no inconvenience from vertigo. The rotation treatment should not be attempted if the ocular fundi indicate increased cerebral pressure. Only chronic cases should be treated by this method.

CASE 2.—Margaret N., aged 58, came to the clinic complaining of severe objective vertigo. There was no history of head injury. For several weeks the patient had experienced severe attacks of vertigo accompanied by nausea, vomiting and an extreme emotional upheaval. Neurologic examination revealed a rotatory nystagmus with a synchronous head movement identical in direction with the eye nystagmus.

The roentgenogram of the teeth revealed several root abscesses. These teeth were removed and within four weeks the vertigo, nausea and vomiting had ceased.

CASE 3.—G. O., aged 35, was healthy until the age of 27, when she developed pulmonary tuberculosis. She was confined in a state hospital for tuberculosis for one year. During her treatment at this hospital she developed vertigo with nausea and vomiting. Soon thereafter she noted a horizontal movement of the head. The vertigo had persisted intermittently and this brought her to the neurologic department of the Massachusetts General Hospital. Physical examination indicated an active tuberculous process in the apex of the left lung.

The neurologic examination was negative, with the exception of left horizontal nystagmus accompanied by horizontal head movement synchronous with the eye nystagmus. The fundi were negative and lumbar puncture revealed no increase in intracranial pressure; consequently the patient was treated by rotation. After eight weeks she feels that she has been greatly benefited.

CASE 4.—J. J. C., aged 12, came to the clinic on account of severe dizziness, accompanied by nausea and vomiting, which had existed for two weeks. The first symptoms were gastro-intestinal pains and diarrhea. This was soon followed by vertigo, nausea and vomiting. The nausea was increased by a sudden change of position. The patient experienced a sensation of falling forward and to the right. At the time of examination no abdominal symptoms were noted.

The pupils were round, equal, and reacted to light and accommodation. The fundi were negative. There was a slow pull of the eyes upward and to the

right with a resulting quick nystagmus downward and to the left. A movement of the head was noted, identical and synchronous with the eye movement.

This patient was treated with phenobarbital, $\frac{1}{4}$ grain (0.016 gm.), three times a day. Within twelve hours he improved, and within one week he was entirely free from vertigo.

CASE 5.—A. R., a young man aged 33, came to the clinic because of attacks of vertigo. For the past six years he has experienced severe attacks of vertigo, nausea, and vomiting, at first at infrequent intervals. Lately the attacks are so frequent and severe that the patient is unable to earn his livelihood. The patient has a typical Raynaud syndrome, which involves both hands and feet. When this is most pronounced his vertigo is most severe. The pupils are round, equal and react normally. The ocular fundi are negative. At times there is diplopia and a right rotary nystagmus. Tinnitus and some deafness of the right ear are present. Caloric tests indicate interference in the right vertical canals or their tracts in the pons.

This patient has been treated by rotation treatment, phenobarbital and other drugs, with little or no improvement. Since he has been given sodium nitrite, 1 grain (0.06 gm.), three times a day, he has experienced less vertigo.

DISCUSSION

DR. J. B. AYER: Is the rotation treatment original with you?

DR. C. L. WOOLSEY: I know of no one else who has used the rotation treatment. I have communicated with men who have used douching with great relief. If the lesion is on one side only, rotation is contraindicated because it would stimulate both end-organs.

THREE CASES OF FOCAL EPILEPSY. DR. W. J. MIXTER.

The three cases to be described, which have come to operation in the past three months, presented certain strikingly similar features. The condition is not uncommon but is well worth keeping in mind. The histories in brief are:

CASE 1.—Baby S., aged 8 months, was seen with Dr. Bronson Crothers. Delivery was difficult and forceps were used. The infant was apparently normal until 4 months of age. Since then he has not been well; he has seemed dull and has had an increasing number of convulsions which start on the left side of the body. The complete examination, including that of the cerebrospinal fluid, was negative except for slight left facial weakness, and increase in the tendon reflexes on the left side.

CASE 2.—Mrs. L., aged 28, was seen with Dr. F. C. Lord. She gave a long history of attacks of weakness in the right arm, which have not disabled her until two months ago. Since then the attacks have become epileptiform in character and have involved the right side of the body. During the past few days she has been aphasic and has shown definite weakness of the right side of the body. For twenty-four hours attacks have been much more frequent, and now occur at about three-minute intervals. Examination is negative except that: The temperature is 101; the pulse 110; she is unconscious; epileptic convulsions which start in the right side of the face and arm occur every three minutes, last about a minute, and become general after the first few seconds. The left side of the body is flaccid between the attacks. The reflexes vary; they are active at times but are abolished after the convulsions.

CASE 3.—Mrs. D., aged 58, was seen with Dr. H. C. Solomon. For the past four years she has had epileptic convulsions which started in the left arm and

left side of the face and then became generalized. There have been periods of weeks when she was free from convulsions; at other times the seizures have been very frequent. During the past few months there have been observed: definite slowing of her mental processes, forgetfulness, etc. Examination was negative except for: Increased density in the right temporal bone revealed by roentgen ray; slowness and forgetfulness; unsteady gait.

All three cases were operated on, and an osteoplastic craniotomy was performed over the affected area in each case. In all the arachnoid was elevated and the space between the arachnoid and the cortex was filled with clear fluid. The area affected was definitely localized, and in all three cases was anterior to the motor cortex. In Case 2 there was a marked increase in the blood supply to the affected area. Numerous small incisions were made in the arachnoid to permit the fluid to run off, and in Case 2 the enlarged veins were ligated in several places. In all three cases striking improvement followed the operation. Baby S. (Case 1) is a large healthy boy, and is apparently normal except for the scar in his head. Mrs. L. (Case 2) is apparently a normal woman. She has had no attacks since the day after operation and is now, two months after the operation, able to use her typewriter. Physical examination is negative. It is now three weeks since the operation in Case 3. During the first five days this woman had numerous convulsions and it was necessary to turn down the bone flap and remove a thin clot which had formed beneath it. Since that time she has passed through an uninterrupted convalescence and is now far more alert than when she came to the hospital.

The pathologic process in all three cases is difficult to understand. There must be some underlying cause for the collection of fluid beneath the arachnoid, but as yet we have no real information as to the nature of the fluid nor of the underlying cause. It may be that cerebrospinal fluid has collected beneath the arachnoid owing to some fault in absorption of this fluid.

DISCUSSION

DR. E. W. TAYLOR: One of these cases which I had an opportunity to study suggested a purely psychogenic origin for the attacks. What, in general, is the ultimate outcome in cases such as you have described?

DR. S. J. MIXTER: Most of the cases have done well but a good many have recurred. I think that is the usual history. These three are satisfactory thus far but it would be interesting to observe them three years hence; I surmise they would not then be so satisfactory. The second case, alluded to by Dr. Taylor, is of rather peculiar interest on account of the very rapid recovery. I also have a strong suspicion that much of her trouble was functional. In none of these three cases nor in many others has there been a choked disk. One might think of a cortical or dural tumor with pressure on the cortex, but whether choked disk has been present or not, recent cases have led me to hazard a diagnosis of fluid under the arachnoid, whatever its origin may be.

SUBTENTORIAL CYST OF MENINGES WITH NECROPSY. DR. JAMES B. AYER.

Mrs. H. M., Armenian, 23 years of age, was admitted to the Massachusetts General Hospital, Oct. 24, 1922. While in Constantinople, two years previously, she began to be troubled with headache, which increased in severity up to the time of admission. Sixteen months before, she married and came to

the United States, where a healthy full-term baby was born. Since delivery, seven months before admission, bi-temporal and sub-occipital headache have greatly increased; at this time also dizziness set in, and for four months there has been difficulty in walking. For two months she has complained of difficulty in the use of her hands and for two weeks there have been imperative micturition and nasal regurgitation of food. Recently she is said to have been forgetful and to repeat her words.

During the period October 24 to November 21, physical examination revealed: The patient was well developed and well nourished; except for scars of previous variola, pyorrhea alveolaris, and a compensated mitral regurgitation, nothing abnormal was found; the stools showed neither blood nor ova; the urine was negative; the blood Wassermann reaction was negative; there was a slight secondary anemia, but the leukocytes were normal in number and proportions.

Neurologic examination revealed in the cranial nerves: Vision was present in both eyes and there was no marked contraction of the fields as judged by the finger test; perimetry was unsatisfactory from lack of cooperation; the fundi presented bilateral choked disk of 4 to 5 diopters; vertical and horizontal nystagmus were constant; ptosis of the right eye and right sided facial weakness were inconstant and of slight degree; there were no subjective or objective disturbance of sensation of the face nor weakness of the jaws; hearing was present on both sides, but bilateral tinnitus was constant; the ear drums were normal; at times there were difficulty in swallowing and nasal regurgitation of liquids; the gag reflex was absent; the tongue was protruded straight and showed no atrophy nor tremor.

In the cerebral function: there was constant awkwardness in the use of both hands but particularly of the right; hypermetria and asynergy were especially marked in the right hand; no spontaneous past pointing was observed at any time; unfortunately lack of cooperation made Bárány tests unreliable; the gait was unsteady, the right side being especially affected; there was a constant tendency to fall toward the right side.

Sensation was usually normal throughout for cotton-wool, pain, heat, cold, and deep sensibility; on two occasions the reactions to needle pricks suggested hyperalgesia over the whole left side, though tactile sensibility was normal.

The arm reflexes, knee and ankle jerks were equal and lively; at times responses suggestive of Babinski and Oppenheim signs were obtained on both sides, but there was no ankle clonus at any time.

November 17, G. W. Holmes reported that pneumoventriculograms showed: The ventricles were rather large, and the right appeared to be somewhat larger than the left. No definite abnormalities in outline were visible.

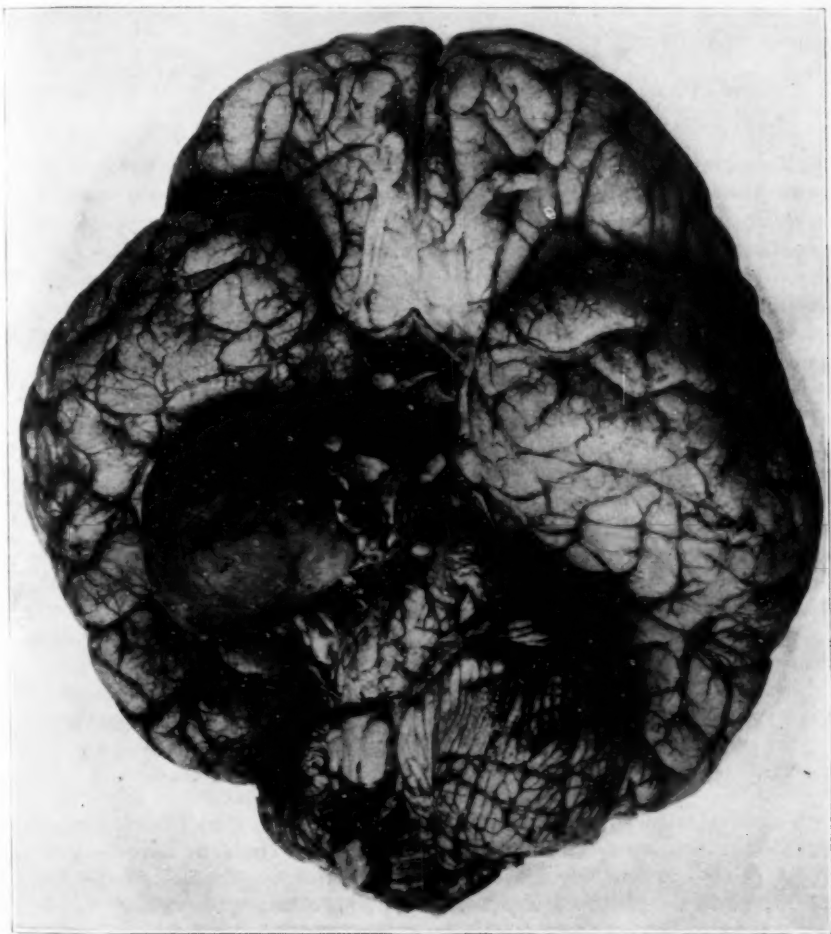
November 21, cerebellar decompression was performed by Dr. J. S. Hodgson. Marked increase of intracranial pressure was found, but no pathological lesion was discovered.

The patient died November 25.

The necropsy was performed by Dr. Oscar Richardson. Examination of the head only was permitted. The brain presented marked flattening of convolutions, indicative of increased intracranial pressure. On the right side, section of the tentorium exposed a cyst-like tumor which rested between the basilar process and the brain-stem. The pedicle sprang from the region of the dura along the right side of the sella turcica and was continuous with the cyst wall. The tumor pressed upon the right crus and the upper part of

the pons, and down along the pons on the right and the superior surface of the right side of the cerebellum. The brain tissue in this region presented a pressure cavity. Otherwise the brain was not abnormal.

After hardening in formaldehyd the cyst was further examined. It was ovoid in shape and 5 by 4 cm. in size. Its contents were yellow and gelatinous, and contained numerous cells filled with fatty granules. No hooklets were



found. The pedicle of the cyst was about 1 cm. in diameter and was composed of cells of uniform character, with small oval or round nuclei and large granular protoplasmic bodies. Interspersed with these cells were bundles of glia and connective tissue fibers. No mitotic figures were seen. In the tumor no areas of degeneration were visible. The cyst wall was of almost uniform thickness, from 3 to 4 mm.; the outer capsule was smooth and covered with connective tissue; the inner wall was rough, but showed no transverse bands. Microscopically the wall of the cyst resembled the pedicle.

Summarizing, it may be said that this patient presented an unmistakable clinical picture of progressive brain tumor localized in the right cerebellar fossa. The cyst, which unfortunately was not found at the operation, is somewhat unusual. It did not at any point invade the brain, and certainly did not arise from the acoustic nerve. Its origin seems to have been in the meninges, and its obvious attachment was to the dura in the neighborhood of the sella turcica. In the absence of a complete postmortem examination it is not possible to state that we are not dealing with metastasis, but the evidence at hand suggests that it is a primary tumor of the meninges, pathologically benign in character.

EXAMINATION OF THE HEART AND AORTIC ARCH BY ROENTGEN RAYS IN NEUROSYPHILIS. DR. C. A. McDONALD.

Roentgenograms of the heart and aortic arch were taken in forty unselected cases of neurosyphilis at the out-patient department of the Massachusetts General Hospital. In eighteen of the forty cases the roentgenogram revealed specific aortic disease; in these eighteen, physical signs of cardiovascular disease were recorded as present in six cases and subjective symptoms of cardiovascular disease in four cases. Sixteen cases were interpreted as arteriosclerosis of the arch, and in them there was no record of signs or symptoms of cardiovascular disease. Two cases had other heart conditions, and in one of these there were physical signs of heart disease. One case showed no arch or cardiac pathology. In two cases no roentgenogram interpretations were given, and in one case the interpretation was given without cardiac measurements. In these last three cases there was no record of physical signs or symptoms of cardiovascular disease.

Summarizing: (1) This study of the records of forty cases of neurosyphilis reveals physical signs of cardiovascular disease in 15 per cent. and symptoms in 10 per cent. (2) The roentgen-ray examination revealed specific aortic disease in 45 per cent., and arteriosclerosis of the arch in 5 per cent. of the cases. (3) Therefore, in 90 per cent. of the forty cases cardiac disease was demonstrated by roentgen ray.

RESUMÉ OF SOCIAL SERVICE WORK IN THE NEUROLOGICAL CLINIC AT THE MASSACHUSETTS GENERAL HOSPITAL DURING 1922. CHARLINE F. BUCK.

The total number of patients in the neurologic clinic to whom social service has been rendered thus far in 1922 is 391. The aims have been threefold: (1) To assist the doctor by making treatment available to and effective for the patient. (2) To instruct students and volunteers in the processes of social work. (3) To contribute material for medical social research.

The methods have varied according to the types of medical case which have been grouped as follows: I. Toxic-organic, with 209 patients, including syphilitic 69, chorea 40, epilepsy 35, paralysis agitans, multiple sclerosis, etc., 65. In this group the efforts were especially directed toward making medical care possible and continuous, or toward arranging institutional care elsewhere if advisable. For instance, financial arrangements for antisiphilitic treatment; loans to the patient or the provision of state medicines; intensive supervision of the hygiene of the choreic; or change of employment for the epileptic. II. Hypophrenic, with forty-seven patients. Efforts here were centered on the investigation of the home care of the child, persuasion of the family

to accept institutional care, the securing of special class training in the public schools, and arrangements for special supervision of adolescents. III. Functional, with 135 patients. Efforts in this group were directed, first, toward understanding the patient's personality, habits, characteristics, and environment; then toward alleviation of the deficiencies and difficulties in his home, work, or play life, instruction in mental hygiene, and arrangement for convalescence or vacation when needed.

In addition to the usual difficulties belonging to Dr. E. E. Southard's five evils, a few of the resistances to be overcome were: (1) Lack of institutions for chronic cases. (2) Lack of convalescent or vacation resources for men. (3) Unwarranted prejudices against public institutions. (4) Lack of "light" jobs. (5) Lack of welfare, educational, and recreational resources in local communities. (6) Inability to secure the cooperation of social agencies in cases with unfavorable prognoses (feeble-minded adolescents).

Social workers have come to depend on definite medical recommendations as a basis for social work. These are sometimes difficult to get. This handicap has been overcome this year, in the group of psychoneurotic patients, by the establishment of an advisory committee of two staff-doctors who examine the case medically, hear the results of social investigation and action, and give definite advice for further action.

For convenience we have grouped the results with 344 patients (the other forty-seven cases are as yet too incomplete) into cases with:

(1) Satisfactory adjustments	151 or 43%
Group I	94 or 51%
Group II	22 or 55%
Group III	36 or 31%
(2) Partially satisfactory adjustments.....	135 or 36%
Group I	64 or 31%
Group II	16 or 40%
Group III	56 or 49%
(3) Failures.....	58 or 16%
Group I	25 or 13%
Group II	2 or 5%
Group III	21 or 18%

DISCUSSION

DR. E. W. TAYLOR: Certainly if these figures are correct this is a most satisfactory showing as compared with what was done fifteen years ago, when we did nothing socially for patients of this type.

DR. C. M. CAMPBELL: In a general hospital one can do a great deal more than at a psychopathic hospital. Social service in a department of a general hospital must have a very wide-reaching effect.

DR. J. B. AYER: These cases seem to demonstrate that the organic cases were better adjusted. What does Miss Buck think is the group in which social service does most for the patient? The first group would require half an hour's time; a functional case might require ten hours' time or more. In which group do you do the best job, and to what cases do you think you ought to devote most time?

MISS BUCK: To give a selfish answer, I prefer work with the functional cases. The statistics look discouraging, but what is accomplished with an individual is often most satisfactory.

DR. C. M. CAMPBELL: One of your three aims is scientific; to see what the study of these cases means for developing social service as a thing in itself; to which group does that apply?

MISS BUCK: I should say the functional group.

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, Dec. 22, 1922

N. S. YAWGER, M.D., *Vice President, in the Chair*

A CASE OF LIPODYSTROPHY. DR. C. A. PATTEN.

This case is presented because of its unusual endocrine interest and because it illustrates a disturbance of fat metabolism which ordinarily receives little attention. Positive facts in the history are as follows: A maternal uncle was a bedwetter until 9 years of age, this condition having been promptly relieved by circumcision. The father and mother are thin, high strung and nervous individuals. There are eight brothers and sisters, the oldest sister being deaf and dumb from birth. The second oldest brother had bladder difficulty until the age of 2, when acute retention of urine necessitated hospital treatment; following circumcision he had no further trouble. The third brother had nocturnal and diurnal incontinence until the age of four; his cure also followed circumcision. The second sister had nocturnal enuresis until the age of 18, and was relieved by an operation for hooded clitoris; she also had an enlarged thyroid gland. Another sister, aged 11½ years, occasionally wets the bed and has also a hooded clitoris.

The patient, aged 10, has been a bedwetter continuously until the past month. Two and a half months ago she was operated on for a hooded clitoris and was then treated in the Orthopedic Hospital for one month. During the past month she has wet the bed on but two occasions. She was brought to the orthopedic clinic by her mother who complained that besides enuresis, the child was fretful, peevish and high strung, and during the past year had been "growing all out of shape." During the past year she has become much less active on her feet and seemed to tire much more readily. This was in striking contrast to her former activity. Relative to her figure, the family noted that the child was very large around the buttocks, thighs and legs, but looked smaller in the trunk and arms. There was a gradual development of this condition until three months ago. Although not poorly nourished, there is a striking difference between the upper and lower halves of the body.

In the hospital she appeared anemic, had a capricious appetite and was a nail biter. The thyroid was distinctly palpable but there were no toxic symptoms. There was marked lordosis in the lumbar region and she had a protuberant abdomen, which is improving with appropriate exercises. The laboratory tests showed a normal sugar tolerance curve though a high percentage of sugar. Blood count: red cells, 4,870,000; white cells, 7,600; hemoglobin, 81 per cent.; polymorphonuclears 43, transitionals 1, lymphocytes 46, eosino-

phils 3, basophils 2. Fluid intake and output in twenty-four hours were 36 and 23 ounces, respectively. Urinalysis was negative; basal metabolism was within normal limits.

Lipodystrophy is much more frequent in women than in men, and usually develops around puberty. Many girls show a tendency to the excessive deposition of fat around the buttocks and lower extremities which is not present in the arms, trunk and head. Occasionally, disappearance of fat in the upper parts produces an appearance of over-deposit below. The over-deposit and waste take place in the subcutaneous tissues rather than in deeper structures, although in pseudomuscular hypertrophy there is, in addition to the subcutaneous, an increase of fat between the muscle fibers. The connection between the muscular dystrophies and lipodystrophy is well worthy of consideration, and I feel certain that future investigations will disclose a similar etiology.

The usual picture of pseudomuscular hypertrophy is that of atrophy of the muscles of the arms and trunk with apparent hypertrophy of the muscles in the lower extremities. In these cases there is no subcutaneous fat in the regions of atrophy, but a marked increase in the thighs and legs. The regions affected in the muscular dystrophies are the same as those involved in lipodystrophy. The difference in the sex incidence of the two conditions is noteworthy; the majority of muscular dystrophies occur in boys, and of the lipodystrophies in girls. Cases are recorded of wasting of fat in the face only, but, curiously enough, the hands and feet are never involved. The condition has not been observed in animals. Six or seven cases of lipodystrophy in males have been recorded, the most recent report having appeared in the *Revue Neurologique* of September, 1922, by Professor Christiansen of Copenhagen.

There seems to be some connection between gonadal and thyroid functions and the occurrence of lipodystrophy. As previously mentioned it develops very frequently around the age of puberty, but it is often observed at the time of the menopause in women and of the senium in men. The general descriptions and appearance of cases suggest thyroid influence. In my patient the thyroid is enlarged though puberty is not yet established; consequently one might, in accordance with Timme's theories of compensatory over-function, predict that there is a lack of ovarian secretion for which the thyroid gland is attempting to compensate.

DISCUSSION

DR. CHARLES S. POTTS: The relation of muscular dystrophy to endocrine gland disturbance is interesting. There has been work done along this line by McCrudden of Johns Hopkins and by Janney, Goodhart and Isaacson of New York. They found definite disturbance of carbohydrate metabolism, as shown by a hypoglycemia, which depended on impaired glycogenesis, the carbohydrates being changed into fat instead of glycogen. They found this due to disease of the adrenals and other endocrine glands. I gave adrenalin to one case at the Philadelphia Hospital, apparently with some improvement. In a case at the Polyclinic we made a metabolic study and found no change in the blood sugar.

DR. WILLIAM G. SPILLER: I am rather dubious about the diagnosis. Lipodystrophy is such an unusual disease that when a case is so abortive as this one the diagnosis must be questionable. The paper by Christiansen alluded to by Dr. Patten is the most recent. Christiansen mentions that in only one case of the six occurring in men, collected by Boissonnas, was there any deposit

of fat about the buttocks. I should find some difficulty in distinguishing between muscular dystrophy and lipodystrophy where the two conditions are associated in the same person. This child has no atrophy of the face. Facial atrophy is commonly found in lipodystrophy of men or women, but there is no case recorded in which only the face was atrophied. I wish Dr. Patten would make more clear to us that this is not a case of muscular dystrophy.

DR. C. A. PATTEN: In answer to Dr. Spiller, I feel that he is correct in suspecting the presence of a muscular dystrophy. Our first thought when we saw the child in the clinic was that we were dealing with a pseudo-hypertrophic muscular dystrophy; but we examined her repeatedly during a month in the ward and could not find any weakness or difficulty in muscular movements. The lordosis and relaxed abdominal walls together with large leg muscles certainly suggest a dystrophy, but under corrective exercises the abdominal tone has improved and the lordosis has been partly corrected. The latter was possibly a postural defect. It is difficult to conceive a systemic condition in which deposits of fat occur in localized regions, but the fact remains that they do develop.

In cases, other than lipodystrophy, known to have disturbances of function of the glands of internal secretion, similar phenomena are observed. In some women at the time of puberty or the menopause, this excessive fat deposit about the thighs and buttocks occurs. This suggests an endocrine relationship. I feel strongly that we shall find an endocrine basis for muscular dystrophies and lipodystrophy. In this case there is enlargement of the thyroid gland and the patient has as yet no apparent pubertal changes.

A case of pseudo-hypertrophic muscular dystrophy at the Polyclinic Hospital was able to get up from the floor without assistance, and to run considerably better after three months treatment with pituitary and thyroid substances. This is but one case, however, and improvement under encouragement must be considered.

As I understand it, the term lipodystrophy applies to a disturbance of fat metabolism. This disturbance may be an atrophy (or failure of deposit) of fatty tissue in one portion of the body, while in other regions there is an increase in the deposit. The regions involved in the atrophy and hypertrophy are the same as those of the muscular disturbances in some muscular dystrophies, and for this reason I infer that there is a possible etiologic relationship between the two conditions. It is significant from the gonadal standpoint that the lipodystrophies are much more frequently found in women, and the muscular dystrophies in men.

CHARCOT JOINT OF THE ELBOW IN A JEWISH WOMAN. DR. EUGENE LINDAUER.

A diagnosis of tabes was made in this Jewish woman twelve years ago; Eighteen months ago she had her first gastric crisis for which a hypodermic injection of morphin was given into the right arm. The next day the site of injection showed violent irritation; when the inflammation had subsided, the elbow joint remained enlarged and presented a typical Charcot joint. A spontaneous fracture developed in the joint later, and there was no subsequent union. The roentgen-ray picture of the elbow is typical of bones thus affected; similar bone disturbances are visible in the right knee joint and in the metatarsus of the right foot. No changes are visible in the wrist of the left side.

DISCUSSION

DR. SHERMAN F. GILPIN: This patient reminds me of a man, whom I saw a few months ago. He worked in a coal mine and believed himself in good health until he lifted a heavy object and hurt one elbow joint in the strain. A diagnosis of Charcot joint was made and confirmed by roentgen ray.

DR. GEORGE WILSON: A patient in Dr. Spiller's service at the Philadelphia Hospital at the present time has, among other trophic disturbances, a rupture of the left biceps muscle which developed after an injection of typhoid vaccine into the arm. This is interesting in relation to the history of the onset in Dr. Lindauer's case.

DR. J. HENDRIE LLOYD: In the roentgen-ray report the statement is made that the disease process in this joint is, in all probability, of syphilitic origin. I do not quite know what that means, but it suggests to me that, Charcot joints may be due to the local action of spirochetes. I believe that someone may yet demonstrate the presence of spirochetes in these joints, as Noguchi demonstrated them in the brains of general paralytics. It is well worth a careful study. The theory that these joint disorganizations are due to "trophic" disorder is vague and unsatisfying. It is much more likely that this extensive destruction of the tissues of the joint is caused by a local agent which acts directly on these tissues.

DR. WILLIAM G. SPILLER: A year or two ago a man with an arthropathy of the elbow was in my service at the Philadelphia General Hospital. The fluid escaped spontaneously from the affected joint and amputation became necessary.

The patient in my service, to whom Dr. Wilson referred, has a rupture of his biceps muscle and an arthropathy of his lower jaw and of his thumb. The rupture of the biceps muscle, I think, may be explained by the tabetic incoordination between agonistic and antagonistic muscles, which prevents the proper degree of relaxation in the antagonistic muscles when the agonists contract. In this case the relaxation of the triceps muscle probably was insufficient to permit the contraction of the biceps muscle and rupture occurred in the latter. I have known the greater tuberosity of the humerus to be broken off by a sudden contraction of the flexor muscles when the opposing muscles did not relax speedily enough.

DR. EUGENE LINDAUER: In almost every case of this nature that I have seen the condition has been attributed to a real or imaginary injury. I recall a man on Dr. Potts' service some years ago who had a Charcot joint of the hip; a physician had applied a mustard plaster to the locality for the relief of pain; the next morning when the patient awoke he found a large mass in the hip and had difficulty in walking. He thought that the mustard plaster was the causative factor. The trophic nature of a Charcot joint is well known, but whether local or central I am not able to say. I believe that a local nidus of spirochetes might be found.

A CASE OF SENSORY DISTURBANCE LIMITED TO A PORTION OF
THE DISTRIBUTION OF THE ULNAR NERVE. DR. ALFRED GORDON.

A woman, aged 31, with a negative past history, began to have trouble with her hand at the age of 20. In the initial attack the fifth finger of the left hand became pale and cold, then bluish and swollen; the finger was incised because of the severe pain, and bloody serum was found. The wound healed

by first intention. Three months later she had a similar attack that involved the fifth and fourth fingers. Three years later the fifth, fourth and third fingers became involved. Five years later she had a similar involvement of the second, third, fourth, and fifth fingers. Two years ago, the patient noticed that when she lay upon her left shoulder and arm the upper extremity became numb and ached. In December, 1920, she had difficulty in grasping and holding objects with her left hand, and it was at this time that she noticed the loss of sensation. During the last six months her arm and forearm ached at times, especially after lifting objects of some weight above her head. She never noticed any blisters or sores upon her fingers.

Physical examination revealed a distinct and very pronounced anesthesia to touch, pain, and temperature on the hand and wrist, covering the area of distribution of the sensory fibers of the ulnar nerve over the palmar and dorsal surface and encroaching slightly on the median nerve distribution. Not only superficial sensation is abolished but there is also a total loss of all deep sensibility including the stereognostic sense. There is no atrophy of any of the muscles of the arm, forearm, or hand. Only a slight amount of weakness in the hand is present. The brachial plexus above and below the clavicle is painful to pressure. All tests, including the Wassermann, are negative. A roentgen-ray picture of the thorax shows a slightly exaggerated curvature of the first rib.

The case is interesting and unusual in view of the strict limitation of the sensory disorder and of its intensity, also in view of the absence of muscular disorder, notwithstanding the duration of the disease. Stookey in his recent book on peripheral nerves mentions disorders of the brachial plexus as a result of perfectly normal thoracic first ribs, in which fibrous bands have been found on the anterior end of the rib pressing directly upon the lower cord of the brachial plexus. The present case may be one of this group.

COMBINED SCLEROSIS OF THE SPINAL CORD OF THE ANEMIC TYPE WITHOUT BLOOD CHANGES. DR. N. W. WINKELMAN.

While there are patients that show the symptoms and signs of a postero-lateral sclerosis prior to the development of change in the blood, very few die without having some of the characteristic blood findings. Such a case I wish to relate. It concerns a man of 37 whom I first saw in March, 1921. He stated that he had been perfectly well until October, 1920, when he noticed numbness in the legs with difficulty in walking and a loss of sexual power. Gradually the disturbance in walking increased; he became uncertain in his gait and his feet felt extremely cold. When examined, the patient had a yellowish color; he was spastic and ataxic in his gait. The deep reflexes were exaggerated with bilateral clonus and Babinski sign. The sensory findings were rather characteristic: impairment of the sense of vibration and of position; tactile, temperature and pain sensibility normal. A diagnosis of postero-lateral sclerosis of the anemic type was made and he was taken to the University Hospital for further study. The red cell counts varied between 3,500,000 and 4,110,000 and the hemoglobin between 75 and 85 per cent. No alteration was seen in the blood smear. The Wassermann reactions of the blood and spinal fluid were negative. Gastric analysis showed absence of free hydrochloric acid. He left the hospital, and after many months was sent to the Philadelphia Hospital, when he was barely able to walk. At this time he showed symptoms indicative of a more or less complete lesion and was thought to have transverse myelitis. His blood did not show evidence of pernicious

anemia even four days prior to death, when the blood count was: red cells, 4,470,000; white cells, 10,300; hemoglobin, 80 per cent. He had developed bed sores and cystitis, which was followed by pyelitis from which he died. The necropsy revealed pyelonephritis; and histologically the spinal cord gave typical but rather advanced evidences of a so-called "combined sclerosis."

DISCUSSION

DR. WILLIAM G. SPILLER: Perhaps the most interesting feature in Dr. Winkelman's case is the excellent condition of the blood a few days before death at the last examination made. In most of the cases of anemic postero-lateral sclerosis in which the blood has been in good condition, a decided anemia has developed shortly before death. I have seen the blood picture fall suddenly a few weeks before the fatal termination. An explanation I would offer for this is that there is a certain reserve power in the blood-making organs and that the apparent good condition of the blood is deceptive. The blood-making organs use their reserve force and work under strain. They employ all the energy they have. Then comes a time when the reserve power is exhausted and the sudden fall in blood count and hemoglobin occurs, and is soon followed by death.

DR. CHARLES S. POTTS: Some of the members may recall a paper published by Putnam about 1891, in which he directed attention to the occurrence of cases of this kind due to causes other than pernicious anemia. I remember that he spoke of chronic diarrhea and malaria which of course might cause secondary anemia. I think Dr. McConnell showed a case to this Society which apparently followed a severe hemorrhage.

INJURY OF ONE PYRAMIDAL TRACT RESULTING FROM A KNITTING NEEDLE PUNCTURE WOUND OF THE CERVICAL REGION OF THE CORD. DR. J. C. YASKIN.

This case is of interest because it presents signs of a traumatic lesion localized in the right pyramidal tract of the cord about the level of the fifth or sixth cervical segments. The patient, 3 years of age, was in good health until Oct. 28, 1922, when he was accidentally struck on the right side of the neck with a knitting needle. He fell instantly and was dazed. Upon regaining consciousness, he was unable to sit up, and it was observed that he had lost power in his right arm and leg. When first examined at the Polyclinic Hospital two days later, he was somewhat dull and apathetic; he had a temperature of 100 and a pulse of 120; and was perspiring profusely on the right side of his head and face. The neck was rigid and the child cried out when an attempt was made to move it. There was a puncture wound of the skin about one-half inch above and one and one-half inches to the right of the sixth cervical vertebral prominence. There was no evidence of facial palsy but the right pupil and the right palpebral fissure were distinctly smaller than those on the opposite side. There was complete flaccid paralysis of the right arm and right leg. There was absence of all tendon reflexes on the right side, and of the cremasteric and abdominal reflexes on both sides. There was a well marked Babinski sign on both sides. As nearly as could be ascertained there was no sensory disturbance on the right side, and no failure of response to pain and temperature on the left. The patient was incontinent from the onset of the trouble. Roentgen-ray examination of the neck and skull was essentially negative; the eye grounds were normal; a lumbar puncture was deemed inadvisable on account of the condition of the patient.

The child did not show improvement until November 4, when he began to move his fingers and raise the right arm at the shoulder. About two weeks later there was evidence of tonicity on the paralyzed side and it was possible to obtain the biceps, triceps and patellar reflexes. In the latter part of November, the right side became definitely spastic, and about December 4, the Babinski sign had disappeared on the left side.

Physical examination now reveals: The left extremities are normal. The right extremities are spastic and paretic but the patient is able to use his arm and to walk with assistance. The biceps and triceps reflexes are present but are not exaggerated. There is a slight flexor contracture of the fingers of the right hand. The right abdominal and cremasteric reflexes are entirely absent. The ankle jerk is about normal. There is a well marked ankle clonus and Babinski sign on the right side. There are no tremors, atrophy, evidences of incoordination, nor of disturbances of sensation. The patient is still incontinent but, owing to his age, there is a question as to whether this condition is due to organic disease.

From the history, clinical course and observation of this case, it would appear that the needle had penetrated to the cord injuring only the right pyramidal tract. The absence of trophic disturbances, as well as the absence of root pains and disturbances of sensation, would lead to the conclusion that there was no involvement either of the gray matter, nor of any of the other tracts. The presence of the Babinski sign on the opposite side was probably due to a temporary edema and the ocular symptoms shortly after the injury were due to the involvement of the sympathetic system.

Book Reviews

BRAIN ABSCESS. Its Surgical Pathology and Operative Technic. By WELLS P. EAGLETON, M.D., Lt.-Colonel, M. R. C., Medical Director, Newark Eye and Ear Infirmary, Newark, N. J. Cloth. Price, \$7.00. Pp. 297, with 40 illustrations. New York: The Macmillan Company, 1922.

The author was possessed of considerable enthusiasm for his subject when he wrote this book, but enthusiasm is essential if one expects to present something worth while. Throughout the work, the author constantly tries to impress on the reader the great importance of detail; therefore, the most minute point in technic is carefully set forth and emphasized. This is an excellent feature, for such attention to detail is seldom found in works on general surgery, and in no field of surgery is detail more essential to success than in surgery of the brain.

While the author's classification of brain abscesses has some merit, it leads to much repetition of description, but perhaps he believed that only in that way could his views be sufficiently impressed on the reader. At times the text is somewhat disappointing, for instance: "In the surgical treatment of encapsulated abscess one of two principles is employed: 1. Attempted eradication of the suppuration. 2. Drainage." The advice is good, but one is left somewhat at sea when the advice is followed by the statement that "Drainage is generally inadequate—and may be the cause of secondary infection of the meninges, the development of the so-called secondary abscess and of hernia cerebri" and that "Complete evacuation, cleansing, and obliteration are impossible." Discordant views are found occasionally, such as "Metastatic abscess follows the occlusion of a cerebral vessel by an infected nidus circulating freely within the blood stream." "The vast majority of, if not all, metastatic brain abscesses are undoubtedly of venous origin—this view explains and is substantiated by the relative infrequency of brain abscess in ulcerative endocarditis." "It is a clinical fact of great importance that while suppurative diseases of the lungs, particularly bronchiectasis, frequently cause abscess of the brain, suppurative endocarditis rarely does so, although the size and directness of the arteries from the heart to the brain would lead one to expect abscess of the brain to be a frequent complication of suppurative endocarditis. Such, however, is not the case." Then follows an analysis of sixty-seven cases of endocarditic emboli from the left side of the heart. Metastatic abscesses occurred in the kidneys fifty-seven times, in the spleen thirty-nine times, and in the brain fifteen times. These figures show that more than 20 per cent. of metastatic abscesses due to emboli from the left side of the heart are really in the brain, and hardly prove the statement that all metastatic abscesses of the brain are of venous origin.

The author's attempt to explain the cause of the subnormal temperature so frequently seen in patients with abscess of the brain on an assumed analogy between the conditions found in patients suffering with abscess of the brain and those found in hibernating animals is certainly far fetched. Conclusions based on analogies are always precarious, but when the analogy involves only a single relation out of many, the conclusion can have no weight.

Notwithstanding these slight defects, the work as a whole, which is well worth while, contains much valuable matter, and the earnest and painstaking manner in which the author presents his subject will go far toward carrying conviction. An excellent bibliography accompanies the text, and there are three appendixes. Appendix No. 1 is "A Guide for Detailed Neurological Examination"; Appendix No. 2, "An Analysis of Pathological Conditions in Reported Autopsies of 125 Cases of Cerebellar Abscess"; Appendix No. 3, "An Analysis of 140 Reported Cases of Frontal Lobe Abscess."

OUTWITTING OUR NERVES. JOSEPHINE A. JACKSON and HELEN M. SALISBURY. Cloth. Price, \$2.50. Pp. 403. New York: The Century Co., 1921.

Singular as it may seem, this book has received almost unanimous praise, not only from the newspapers and lay journals, but also from the medical press and even from the orthodox psychanalytic press. It is a popular presentation of Freudian principles, simply written and coherently constructed. From the standpoint of the thoroughgoing Freudian it is an exceedingly sugar-coated presentation. Only the elementary principles of Freudian theory and practice are discussed, and in this sense the announcement that it is a "comprehensive presentation" is inaccurate. In the last third of the book illustrations are cited which deviate from the Freudian conceptions espoused in the first part, and approximate more to the technic and methods of Dubois, Dejerine and Janet.